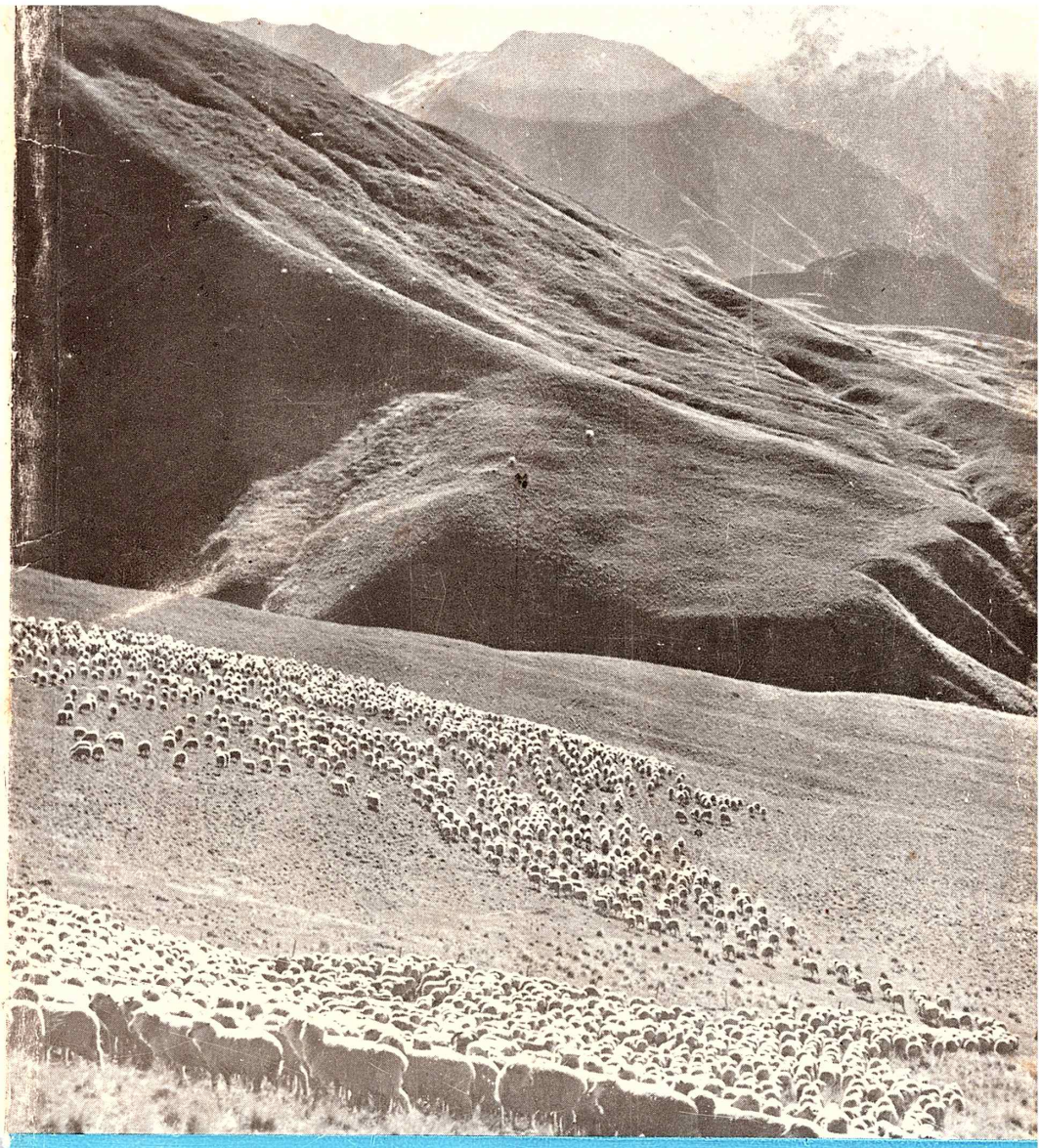
SHEEPFARMING ANNUAL 1962



SHEEPFARMING ANNUAL 1962

MASSEY COLLEGE

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SHEEPFARMING ANNUAL

1962

SHEEPFARMING ANNUAL 1962

Including the Proceedings of the Twenty-fifth Annual Meeting of Sheep Farmers conducted by Massey College, Palmerston North, on June 26–28, 1962, together with

INDEX 1932-1962

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R. A. BARTON

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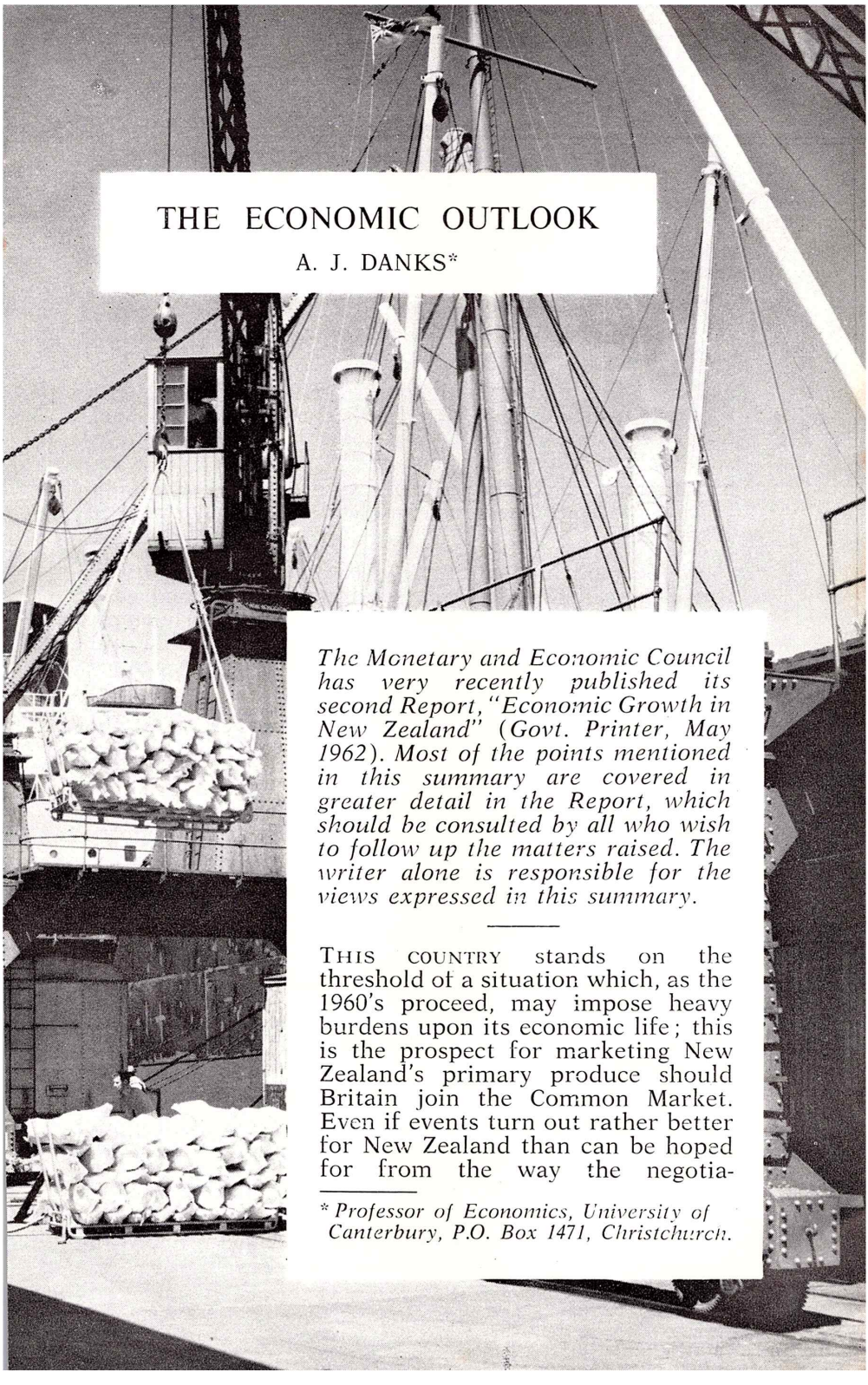
TWENTY-FIVE YEARS

THE 1962 Meeting of Sheep Farmers recorded in this issue of the *Sheepfarming Annual* was the 25th such gathering of farmers conducted by the College. Beginning in 1932, and with the exception of the years 1941 to 1946 when the war caused their suspension, meetings have been held annually and have grown steadily in scope and in the numbers attending them. To mark the 25th meeting, the College entertained 250 guests at a social function in Palmerston North.

The Chairman of the College Council, Mr E. D. Holt, introduced the Minister of Agriculture, the Hon. B. E. Talboys, who paid tribute to the work achieved by the College through the meetings, to Sir Geoffrey Peren, the first principal of the College, and to the late Professor Riddet, who had played a major role in the development of dairy research. It was the tradition established by these two men that had given the College its reputation, and which had maintained attendance of sheepfarmers at the meetings. The name of Massey College had been established internationally and the papers presented at the Meetings of Sheep Farmers were read in libraries and colleges in many parts of the world.

Sir Geoffrey Peren spoke of the first conference 30 years ago which had been held with the idea of promoting co-operation between the College and sheepfarmers, and in particular with the Romney Association. He recalled that at one of the earliest meetings the first step towards the establishment of the Wool Board was taken, when the then Prime Minister, Mr George Forbes, who attended the meeting, was approached about the formation of a sheep and wool research organization. Mr Forbes agreed that, if farmers' support could be obtained, the necessary legislation would be enacted. At first the farmers were sceptical, but it was in the following year that legislation leading to creation of the Wool Board was passed.

Massey College, he said, was very proud of the Meetings of Sheep Farmers. They had been a meeting-ground for all who were interested in any way in the sheepfarming industry, and their increasing strength and the growing numbers of young farmers who attended them testified to the soundness of the sheepfarming industry.



THE ECONOMIC OUTLOOK

A. J. DANKS*

The Monetary and Economic Council has very recently published its second Report, "Economic Growth in New Zealand" (Govt. Printer, May 1962). Most of the points mentioned in this summary are covered in greater detail in the Report, which should be consulted by all who wish to follow up the matters raised. The writer alone is responsible for the views expressed in this summary.

THIS COUNTRY stands on the threshold of a situation which, as the 1960's proceed, may impose heavy burdens upon its economic life; this is the prospect for marketing New Zealand's primary produce should Britain join the Common Market. Even if events turn out rather better for New Zealand than can be hoped for from the way the negotia-

* *Professor of Economics, University of Canterbury, P.O. Box 1471, Christchurch.*

tions now appear to stand, the middle-term marketing prospects are still not very promising. Everything indicates that the economic situation in New Zealand should be looked at with care, much as a vessel at sea will attend to making itself especially shipshape when bad weather is expected.

Criticisms of New Zealand's economic condition fall into two related general categories:

(a) Slow economic growth in the 1950's compared with other overseas countries. Implied in this is some lack of economic efficiency and some lag in productivity which should not be ignored.
(b) Unbalanced economic progress exemplified by inflation, balance of payments difficulties and shortages of labour.

New Zealand has simultaneously aimed at stability of farm incomes, and real wages, full employment and good welfare benefits, a stable exchange rate, and a lavish supply of urban housing. Not all these goals are compatible; the ends have been willed without ensuring the means, against a background of fluctuating export prices.

The Monetary and Economic Council suggests that the country's economic progress requires rationalization by a planning operation designed to:

(a) Establish a set of objectives for output, employment, prices and the balance of payments which the country should be able to achieve.
(b) Assess the rate of growth of expenditure and income compatible with the above.
(c) Assess rate of growth of Government and local body expenditure consistent with the above.
(d) Formulate measures to ensure an adequate rate of capital formation, and improved efficiency.

The Council considers that this planning can be done by investigation, consultation, and agreement, without rigid authoritarian direction of the economy in detail.

Whether a planning scheme is adopted or not, the following matters should receive attention in policy:

(a) Dealing with the shortage of overseas exchange.
(b) Improving productivity.
(c) Keeping increases in spending and income in line with increases in available goods and services.

The Overseas Exchange Problem

Borrowing from overseas should not be ruled out, but it is not a cure. Rather should borrowing "buy time" for internal adjustment to improve earning capacity and productivity and reduce the strains and distortions of inflation.

Devaluation seems to meet many of the needs of the current situation. But it is such a potent means towards inflation in a situation already dangerously strained that one must hesitate to commend it. "Cold devaluation" might be achieved by an "across-the-board" import duty, and by differential taxation devices or subsidies designed to further exports.

It goes without saying that aggressive searching for profitable new or extended overseas markets should proceed apace, and that expenses in the search should not be the subject of injudicious thrift.

All internal industrial expansion, which is an inevitable consequence of New Zealand's economic growth, and which can be made to reduce dependence on overseas earnings, must take regard of the need for reciprocal importing as a condition of attaining new sales of produce abroad.

The criterion of saving of overseas exchange is a dangerous one upon which to judge new industrial developments if it is not accompanied by other considerations such as — competitive efficiency of the industry in New Zealand, ability of the industry to export some or all of its products, and ability to match landed costs of imported products.

The Council believes that the possibilities which lie in an Australian-New Zealand Customs Union should be more closely examined.

Even if success should attend some of the measures mentioned above, together with some further balancing of internal activity, the balance of payments difficulty seems to stand squarely athwart the path to higher standards of living in the 1960's. We frighten ourselves about unemployment; greater cause for worry is shortage of overseas exchange and the consequences which flow from this.

Improving Productivity

Government should, properly, be expected to do a good deal to guide economic destinies in an economy like New Zealand's. But there are activities where citizens and private businesses must help themselves to help themselves. In attitudes to productivity and in management there must be self-criticism. Is there a really serious "she'll be right" attitude?

It should be realized that restrictive practices by labour or by business are totally unsuited to an economy suffering from inflation and short supply of imports.

It is not certain that the taxation system encourages efficiency of enterprise. This is a big topic, but revenue considerations and equity considerations are not enough in a siege economy. The writer has long thought that company taxation is too high.

Public expenditure should be programmed in order to prevent the inefficiencies which come from fluctuations, especially on capital works expenditure.

Research and education will have a growing part to play in raising productivity. A growing proportion of the national income will have to be devoted to these.

It must be considered whether new welfare or social expenditures can be afforded as well as more direct investment in productivity, and the capital plant this calls for.

Is the public revenue system of high taxes on incomes and profits, and relatively low ones on commodities, conducive to productive efficiency, capital accumulation, and the right sort of personal economic motivation?

Direct controls in New Zealand frequently favour the established business against the new, the conventional against the novel. The new car market is an example of an arthritic structure not even doing what it is intended to do — save overseas exchange. Greater flexibility is not easy to achieve in today's conditions, but more reliance upon price directives and less on direct controls may aid the economy to use its limited resources more productively.

Finally, there is the point on which there is growing public awareness — that very good use is not made of the capital stock that is already held. Working customs are often such that valuable equipment stands idle for all the hours of the week except the magic forty. Some breakdowns in the rigidities of economic life and customs are necessary to spread overhead costs and use existing plant more effectively.

Co-ordinated Stabilization Policy

New Zealand's economic achievement since the war has been maintaining full employment. But in other ways the record has not been good, as this summary has already pointed out.

Among the means towards greater stability in the country's affairs, and more effective control of inflation and the

consequential balance of payments troubles, the following points may be considered:

— Farm price support schemes might be clearly related to realizations, with ceilings as well as floors. Such a reform would call for positive attention to keep down the rise in farm costs and to prevent the reserve funds from inflating the internal economy, partly, perhaps, by increasing short-term overseas exchange holdings.

— General wage orders should be made on criteria very closely concerned with increases in actual productivity.

— Budgetary policy and credit and interest rate policy should co-ordinate to restrict excess demands.

— Government must enable itself to exercise firm policy at the cost of some unpopularity.

— Longer Parliamentary terms may be an effective engine of economic reform.

This is a brief, and perhaps rather cryptic shopping list of matters which may warrant public and official attention in the years to come. The problems will not be easy to resolve, and no claim is made here for facile remedies; and certainly the Monetary and Economic Council makes no such claim in its Report.

But there is some evidence that economic policies in the past have been conducted partly in the hope and expectation that something will turn up — the prices of one or more of our export staples. In the 1960's this Micawber philsophy may be applied in vain, and some of the suggestions given above are offered as substitutes for hopeful inaction.

DISCUSSION

Q : : *If meat and wool production were increased by 50 per cent., would the total revenue be increased by this amount?*

A : : A precise answer is impossible. Here are some guesses. Wool: Perhaps not the whole 50 per cent., but substantially more total revenue would accrue. This is because we are not very large suppliers to a wide market. I ignore special problems of wool grades and markets associated with them. Meat: Too vague. For lamb, decidedly not. We would depress the British market. For mutton, possibly not, but circumstances vary from season to season. For beef, perhaps pretty near it. For pork, the same.

Q : : *There must be a limit to the productivity per man and if this is already reached, how can you expect further increases in productivity?*

A : : Why should there be a limit on the whole production picture where labour is helped by capital and knowhow? I can and do expect further increases in productivity.

Q : : *Many small farms are being absorbed by larger farmers. Would it not be better to keep these small farms as units by means of subsidies to their owners rather than subsidizing secondary industries?*

A : : This question is extraordinarily complex looked at in depth. But we must beware of the assumption that, if secondary industry in New Zealand is inefficient in some plants, this gives us a licence to encourage inefficient farming. And are these small farms inefficient? Like a certain well-known figure, I will not stay for an answer. But, clearly, the relationships between size and efficiencies in farming lead on to specific studies, in which this sort of generalization does not help much.

Q : : *Would a discovery of copious quantities of oil be the economic fairy for the 1960's?*

A : : Yes, indeed. I could think of some more, too.

Q : : *Is it good for the internal economy when farmers sell wool by auction but must buy all their requirements at a fixed price?*

A : : There are some free markets apart from that for wool. A freer internal economy in New Zealand presupposes some change of economic philosophy, and considerable political policy action. This may be right or wrong, but it cannot stem from a "wool auction" analogy alone.

Q : : *Overseas agriculture is subsidized and this has produced surpluses of many products. In New Zealand, however, agriculture is not subsidized and products are cheaply produced. Could not these two facts be taken into account in getting favourable trading with E.E.C. countries for New Zealand's dairy and meat products?*

A : : We can try. But Western European farming is both subsidized and relatively poor. The economic logic of this question looks a bit chilly to European peasants, struggling along behind their urban fellow countrymen. And their votes would quickly demonstrate this.

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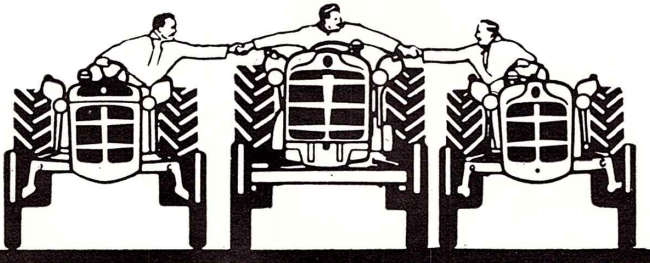

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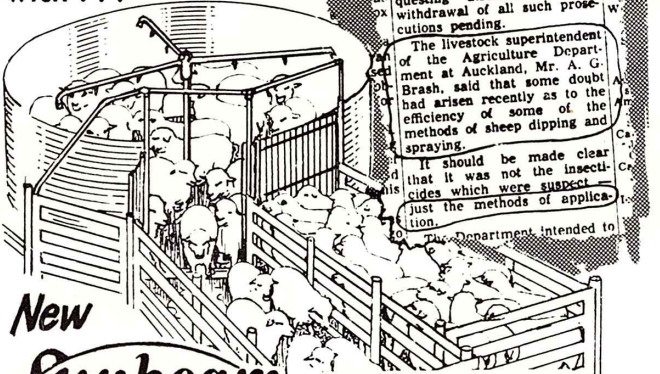
Lice Control Survey
AUCKLAND, July 22 (P.A.)—Prosecution of farmers who market lice-infested sheep will be discontinued until the Department of Agriculture has completed a New Zealand-wide survey of spraying and dipping methods.
The Director-General of Agriculture, Mr. D. N. Webb, today issued a directive requesting discontinuance or withdrawal of all such prosecutions pending.
The livestock superintendent of the Agriculture Department at Auckland, Mr. A. G. Brash, said that some doubt had arisen recently as to the efficiency of some of the methods of sheep dipping and spraying.
It should be made clear that it was not the insecticides which were suspect — just the methods of application.

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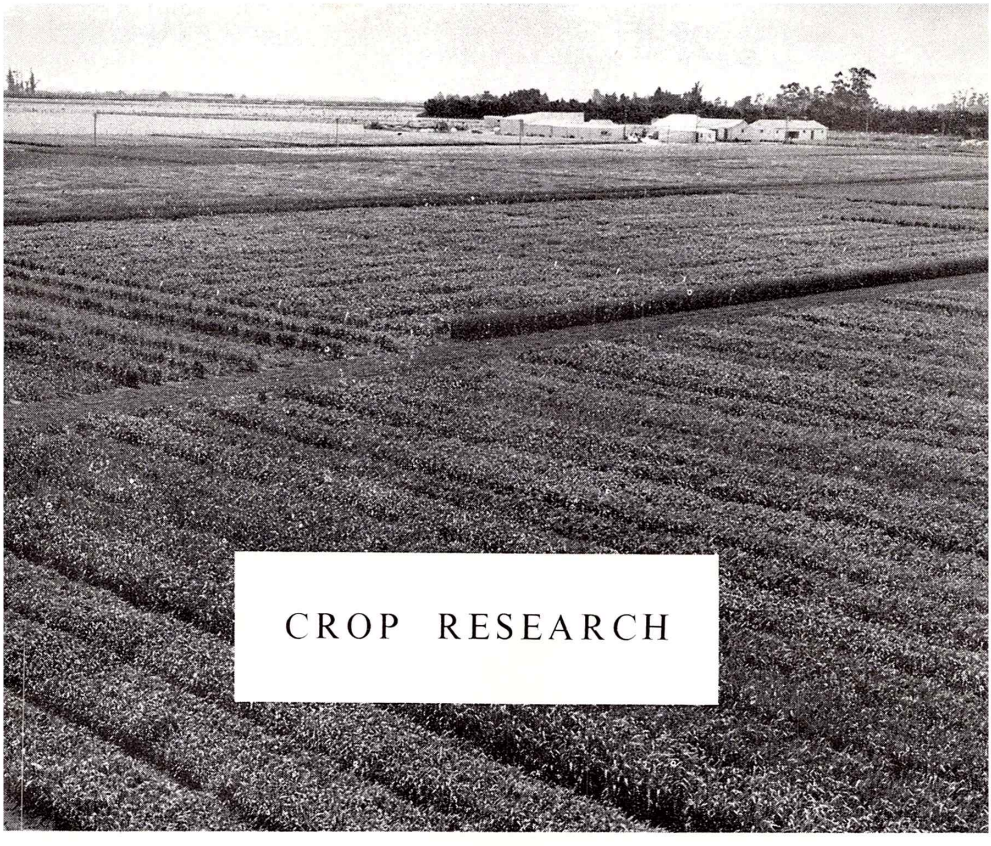

CROP RESEARCH

L. CORKILL*

THE CROP RESEARCH DIVISION is a branch of the Department of Scientific and Industrial Research and is responsible for breeding improved field and vegetable crops and for the production of nucleus seed of these for the Government Seed Certification Scheme.

The Division is located at Lincoln along with other branches of the Department who are carrying out various lines of research closely related to that of the Crop Research Division. There are many problems of plant improvement which require collaboration between plant breeders and specialists in other branches of science. For instance, plant diseases and insect attack may severely limit production and the plant pathologist and entomologist may be able to assist in breeding for resistance to such attacks. Crop yields depend not only on the inherent ability of the plant for higher production but also on the environment in which

* *Director, Crop Research Division, Department of Scientific and Industrial Research, Private Bag, Christchurch.*

the plant is grown. It is in this connection that the soil scientist, the biochemist, the physiologist, and the plant ecologist can assist the plant breeder. In breeding improved plants and testing their performance, the plant breeder has to distinguish between inherent and environmental effects. In this work the statistician can assist in the designing of experiments and in the interpretation of results.

It is for these reasons that personnel of a number of other branches of D.S.I.R. are located alongside the Crop Research Division — from Plant Diseases Division, Auckland; Grasslands Division, Palmerston North; Entomology Division, Nelson; Soil Bureau, Wellington; and Applied Mathematics Laboratory, Wellington.

Final testing of bred varieties in the field is carried out at regional substations and on farms in collaboration with the Department of Agriculture.

This centralization of research units is sound organization. The research workers have the advantage of common facilities, and close association between workers in different fields acts as a stimulus to individual and collaborative work. Regional problems can best be tackled by personnel located at regional substations. If, for example, a wheat variety suitable to the Manawatu were required, it could best be produced by carrying out the plant selection at a substation located in that region.

Cropping in the New Zealand Farming Pattern

New Zealand is primarily a pastoral country and the area in crops is small compared with that in grass, as is shown in Table 1.

TABLE 1: Acreage in Crops, 1959–60 (thousands of acres)

	North Island	*South Island*	*New Zealand*
Wheat	12	154	166
Oats	6	75	81
Barley	14	59	73
Maize	14	1	15
Peas	3	25	28
Potatoes	10	11	21
Turnips & Swedes	103	334	437
Rape	14	133	147
Choumoellier	88	62	150
Lucerne for hay	21	118	139
Other	16	35	51
Total	301	1,007	1,308
Sown to pasture 1959–60	277	496	773
Total sown grassland	12,710	5,840	18,550

The area of sown grassland is about 18,550,000 acres, while that in crops is only 1,308,000 acres, of which 77 per cent. is grown in the South Island.

The dependence on pasture is obvious and most of this is permanent pasture with very little renewal being practised, particularly in the North Island where only 277,000 acres of new pasture (including that sown on virgin country) is sown per year. This represents only 2.2 per cent. of the North Island area of sown grassland. The picture is very different in the South Island where, although the area of sown grassland is only half that in the North Island, the acreage in crops is 3½ times greater. A natural consequence of the more arable farming is the greater rate of pasture renewal. The annual renewal of 496,000 acres of pasture represents 8.5 per cent. of the sown grassland — four times the percentage renewal in the North.

The most important crops on the basis of acreage grown are wheat and the brassicas (turnips, swedes, rape and kales). This latter group is used almost totally as a summer and winter supplement to grass and it is this group that is at present of most significance to North Island farming although food crops such as the cereals could fill a much more important role in the pattern of North Island farming than they do at present.

Crop Varieties Produced by Crop Research Division

Some 45 varieties or strains of crop and vegetable plants have been selected or bred by the Division and certified seed released to users. Before release, new varieties are tested against standard varieties at research stations and on farms. Should the trials show that the new variety is better than those in use, a nucleus supply of seed is produced by the Division and released to farmers under the Government Seed Certification Scheme. Some of the earlier varieties released are not now used, having been replaced by improvements, but there are still 35 of the Division's varieties or strains being grown. Only a few of these will be discussed — wheat, barley, and some of the brassica forage crops.

Wheat

WHEAT PRODUCTION

The wheat acreage grown in New Zealand is determined primarily by the tone of the market for fat lamb and wool, and with the lower prices for these products in recent years

there has been a steady increase in wheat production as shown in Table 2.

TABLE 2: Wheat Production

Year	*Area*	*Yield (bushels)*	*Yield per acre (bushels)*
1957	65,743	2,950,273	44.9
1958	83,936	3,727,117	44.4
1959	132,913	6,038,822	45.4
1960	163,158	8,700,199	53.3
1961	187,000	9,288,000	49.7

In the last five years there has been a steady increase in the acreage grown from 66,000 to 187,000 acres and in yield from 2,950,000 to 9,288,000 bushels.

New Zealand is still by no means self-sufficient in wheat. Self-sufficiency would require the production of about 16,000,000 bushels, so at present 58 per cent. of total requirements is being produced. The balance is imported from Australia to the North Island as production in the South Island is sufficient to meet its own requirements.

WHEAT BREEDING

In the breeding of wheat attempts to satisfy three groups of people are being made. The growers want a wheat with high yield, resistant to disease, suitable for direct heading, and resistant to lodging, shattering and sprouting. The millers require easily milled wheat with a high yield of clean flour, and the bakers want a high-quality wheat which will produce a good loaf of bread. The problem for the wheat breeder is to combine all these characters in the one variety.

Modern varieties bred by the Division are based on multiple crosses to combine the required characters from a number of varieties. The programme is speeded up in the early stages by growing progeny plants in growth chambers in which temperature and light are controlled. By this method four generations can be obtained in a year. But even then it may take at least 16 years to breed and test a new variety and produce a small quantity of pure seed.

Tests for milling and baking quality are made by the Wheat Research Institute, and the performance of selected lines in the field is determined by trials in the wheat-growing areas in co-operation with farmers and the Department of Agriculture. Should a new variety warrant release, seed is produced under the guarantee of the Government Seed Certification Scheme.

WHEAT VARIETIES

Practically all of the wheat grown in New Zealand is of varieties produced by the Division. For many years Cross 7

was the predominant variety but it has now given way to Aotea. Changes in the predominance of different varieties over the last six seasons are shown in Table 3.

TABLE 3: Wheat Varieties for Milling — Percentage of Total Production

Variety	*1956*	*1957*	*1958*	*1959*	*1960*	*1961*
Aotea	—	—	0.02	7.0	85.7	86.0
Arawa	1.5	19.1	43.9	56.2	6.3	11.0
Cross 7	68.6	60.3	32.1	23.4	2.7	0.7
Hilgendorf	3.8	3.0	10.8	8.1	1.6	1.0
Gabo	0.02	0.7	4.9	2.2	2.2	0.6
Tainui	5.5	8.0	5.1	1.2	1.2	0.3
Festival	—	—	—	—	—	0.1

Cross 7 yielded pride of place first to Arawa and then to Aotea — varieties which outyielded it by about 25 per cent. Arawa is poorer in quality than Cross 7 but is well suited for growing in parts of South Canterbury and North Otago. The breeding of Aotea has been a major triumph for the cereal breeders, for not only is its production some 25 per cent. greater than that of Cross 7, but also it has all the agronomic qualities that made Cross 7 so popular for many years. It has a short stiff straw and, with its consequent resistance to lodging, is an ideal wheat for direct heading. Its milling and baking qualities are similar to those of Cross 7. It was produced from a compound cross of four varieties — Federation, Hope, Dreadnought and Cross 7.

The ready acceptance by the farmer of an improved variety is demonstrated by the history of Aotea. A small supply of this wheat was released in 1958 and by 1960 86 per cent. of the wheat harvested for milling was of this variety. Even in the North Island it has tended to replace the two previously favoured varieties, Gabo and Tainui.

A recent major advance towards breeding a high-quality, high-yielding wheat has been the breeding of Hilgendorf (1961). The original Hilgendorf variety released in 1947 is a wheat with good milling quality and excellent baking quality, but its yield is lower than that of Cross 7 and much below that of Aotea. A new strain, resistant to mildew, was released in 1961. This strain is similar to the original Hilgendorf in agronomic characters and in milling and baking quality, but is significantly higher in yield even in the absence of mildew. In fact, in districts to which it is suited, its yield is comparable with that of Aotea. If the new strain maintains the promise already shown, it is likely to be grown much more widely than the original variety and may, therefore, have a significant beneficial effect on flour quality.

WHEAT IN THE NORTH ISLAND

In Table 4 the acreages of wheat grown in the various land districts of New Zealand are shown.

TABLE 4: Wheat for Threshing — Land Districts, 1959–60

Land District	*Acres*	*Percentage of total*
North Auckland	5	—
South Auckland	160	—
Gisborne	54	—
Hawke's Bay	3,135	2
Taranaki	27	—
Wellington	8,011	5
Marlborough	5,131	3
Nelson	323	—
Westland	0	—
Canterbury	108,361	66
Otago	22,713	14
Southland	15,238	9
North Island	11,392	7
South Island	151,766	93
New Zealand	163,158	100

Of the 163,158 acres of wheat harvested in New Zealand in 1960, only 11,392 acres, or 7 per cent., were produced in the North Island, and practically all of this in the Land Districts of Hawke's Bay and Wellington.

It is Government policy to grow more wheat in New Zealand. This is sound for two reasons. First, greater local wheat production would result in a saving of overseas funds; at present wheat to a value of almost £4,000,000 is imported from Australia. And, secondly, with overseas markets as they are at present, some diversification of farming practice is of advantage to the farmer. Wheat is a crop that usually fits in well with a sheep farming pattern.

If New Zealand is to be self-sufficient in wheat, a total production of 16,000,000 bushels is required, which, with an average yield of 50 bushels per acre, would be produced from 320,000 acres. The average in 1961 was about 187,000 acres. So self-sufficiency would require an increase of 133,000 acres or 71 per cent. In the four years since the "low" of 65,743 acres of 1957, the acreage has increased by almost 300 per cent., made up by successive annual increases of 28, 58, 23 and 16 per cent. It is by no means beyond the bounds of possibility that over the next few years the 71 per cent. increase could be attained.

Where is the extra production likely to come from? The district most suited to wheat production from the point of view of both climate and farming patterns is undoubtedly

Canterbury which at present produces two-thirds of the wheat crop. Much of the increase will come from there. It has been shown by the Department of Agriculture that an increase of 47 per cent. on the 1961 area could be attained without any modification in the present farming pattern and without any decrease in stock numbers. The next most important wheat-producing district is Otago-Southland, which in 1961 grew 25 per cent. of the total crop. There is here also a great potential for increased production as spring-sown wheat is favoured in the crop rotation, and, with the increase of grain-drying plants on farms, unfavourable harvesting weather is now of little account.

But the North Island could also grow more wheat, particularly in those districts where it is grown at present, the Hawke's Bay and Wellington Land Districts. Already the South Island is more than self-sufficient in wheat production and the surplus is transported to the North Island. But transportation costs from the South Island are not appreciably different from those from Australia. Costs may be reduced to some extent when the rail ferry is in action but even then the extra one shilling per bushel paid to the North Island grower for milling wheat should make wheat growing a good proposition to the sheep farmer who is able to fit it into his farming pattern. At 14s 6d a bushel and a yield of 48 bushels per acre (the 1960 average yield in the North Island), wheat should provide an attractive addition to the farm income, particularly where the farmer already has the requisite farm machinery for wheat production. At present only a very small proportion of the land suitable for wheat in the Wellington and Hawke's Bay Land Districts is being used for this purpose. It should not require much effort to double or even treble the area.

None of the Division's wheat varieties is entirely suitable for North Island conditions, where stem rust and lodging can seriously reduce yields. However, the varieties Aotea, Tainui and Gabo, although all susceptible to stem rust, are reasonably well adapted to the conditions in the Hawke's Bay and Wellington Land Districts, and usually produce good crops there. Elsewhere in the North Island, successful wheat production requires the use of rust-resistant varieties. At present there are small seed supplies of two stem rust-resistant Australian varieties derived from Gabo — Gamenya and Mengavi. These two wheats may prove useful for areas where stem rust is a problem but in general Australian wheats are not entirely satisfactory for North Island conditions. They have been bred under very different climatic conditions and may not be sufficiently resistant to

sprouting, to lodging, and to mildew and other diseases, when grown under high rainfall conditions. Varieties bred specifically for these conditions are likely to prove more successful, but it takes 15 to 20 years to breed and test a new wheat variety.

A wheat to be well suited for use in most of the North Island would need to be an early ripening variety, resistant to stem and leaf rusts and mildew, resistant to lodging and sprouting, and have good milling and baking quality and high yield. As the environment in most of the North Island is so different from that at Lincoln, the progeny testing and field selection would have to be done in the North. This could best be done by establishing a substation in the region. In spite of the difficulties, however, if there is to be an appreciable increase in wheat production in the North, a project to breed adaptable varieties should be commenced. Some progress has already been made towards breeding a stem rust-resistant Hilgendorf wheat, and, in spite of the fact that it is being bred at Lincoln, its resistance to rust and to sprouting may render it suitable for use in parts of the North Island. Should this prove to be so, it would be a very significant advance, for if it had the excellent milling and baking quality of the present Hilgendorf it would enable the North Island farmer to produce wheat readily acceptable to the miller and baker.

Barley

The area of barley grown in New Zealand has increased to an average of 70,000 acres per year over the last five years. Of this acreage 16 per cent. is used as green-feed, 34 per cent. as feed barley and 46 per cent. for malting. The growing of barley for malting is restricted to the Marlborough, Nelson, Canterbury, and North Otago districts. About 17 per cent. of the total barley acreage is produced in the North Island where it is grown for use as feed barley or for green-feed. As a cash crop in the North Island, barley has some advantages over wheat in that it can be sown later in the spring with a fair assurance of obtaining a good crop.

Until recently the Division has not undertaken breeding of barley but has restricted its work to the introduction and testing of varieties from overseas, manurial and variety trials carried out with the Department of Agriculture, and plant selection in variable introduced varieties to produce uniform lines of nucleus seed. The New Zealand "Research" variety was produced by selection from an Australian variety which exhibited wide variation when grown in New Zealand. However, a full-scale breeding project is now

under way to breed improved varieties of malting and feed barleys suited to New Zealand conditions. Although the varieties originating from overseas now used in this country are reasonably well adapted to conditions here, it is highly probable that better varieties could be bred in New Zealand.

The main malting and feed barleys now in use are Research, Kenia and Carlsberg. The two former are good malting varieties. Research is the higher-yielding on the lighter soils and in dry seasons but is rather weak in the straw for growing on the heavier land where it is inclined to lodge. Carlsberg was introduced from Denmark as a malting barley but has proved unsuitable for commercial brewing. Its high yield, however, renders it very suitable for growing as a feed barley. It has now been tested in a large number of field trials sown by the Department of Agriculture and the Crop Research Division. On the average its yield is about 15 per cent. higher than that of Kenia or Research. Its superiority over these two will undoubtedly result in an increased use as a feed barley in the North Island. Seed has been increased under the certification scheme and there should be ample available for this season's sowings.

Brassica Forage Crops

This group, which includes choumoellier, rape, turnips and swedes, is grown as a winter or summer supplement to pasture and accounts for about half the total acreage of crops grown in New Zealand. Very little rape is grown in the North Island but there is a significant acreage of the other brassicas. Indeed, the area of choumoellier is greater than that grown in the South Island. The acreages of brassica forage crops are shown in Table 5.

TABLE 5: Acreage of Brassica Forage Crops, 1959–60

	Choumoellier	%	*Rape*	%	*Turnip*	%	*Swede*	%
North Island	87,750	59	14,400	10	57,800	23	45,000	25
South Island	62,250	41	132,600	90	196,200	77	138,000	75
New Zealand	150,000	100	147,000	100	254,000	100	183,000	100

CHOUMOELLIER

Two varieties of choumoellier bred at the Division are on the market — giant and medium stemmed. Both were bred by the late R. A. Calder and the first nucleus seed supplies were produced in 1944. The Division still maintains both varieties and produces nucleus stocks of seed for increase.

The main differences between the two varieties are in total yield, height of growth and relative ratio of stem to leaf, the giant variety being the taller, higher yielding and having a higher stem to leaf ratio. Both are highly resistant to aphid attack, virus diseases and club root.

RAPE

Rape is used primarily as a summer supplement to pasture and as a fattening crop for weaned lambs. As its greatest value is in those areas where pasture production in the summer is generally low, it is grown to a much greater extent in the South Island, particularly Canterbury, than in the North.

Four varieties are available as certified seed, and each has some characteristic which may render it preferable to the others for certain purposes.

The giant variety is the most productive but its tall growth, pronounced stem, and disinclination to ripen readily have resulted in its use being confined largely to the drier areas and to soils of low fertility where its shortcomings are not so evident.

The most popular variety is Broad Leaf Essex which was produced from crosses between imported English rapes and giant rape. It is not as tall growing as the giant type, is leafier and ripens more readily. Clubroot-resistant rape was selected by the Plant Diseases Division of D.S.I.R. from giant rape. It is highly resistant to club-root disease.

The most recent addition to the rape varieties is aphid-resistant rape. This variety is likely to become extremely popular, particularly in Canterbury, where infestation of the rape crop by aphids may seriously reduce yield or completely destroy a crop. Aphid attack has a twofold effect — on the one hand, the insect reduces yield by feeding on the plant, and, on the other, it transmits a virus disease which further reduces yield or may destroy the plant. Aphid attack is usually most severe in dry seasons when pasture production is low and a supplementary crop is most required. Under these conditions, aphid-resistant rape can be extremely valuable.

Aphid-resistant rape was bred from crosses between Calder swede (which is resistant to aphid attack) and Broad Leaf Essex rape. The hybrids showed extreme variability from swede-like plants on the one hand to rape-like individuals on the other. By repeated selection for resistance and for rape-like characteristics, a variety was eventually produced which was resistant to aphid attack, similar to rape in appearance, as high-yielding as Broad Leaf Essex in the absence of aphids, and much superior in their presence. In lamb-fattening trials the line was the equal of Broad Leaf Essex. Certified seed is now available. The demand for seed has been keen, particularly by farmers in areas where aphid attack can be expected.

Although this variety is resistant to aphids, it is not immune. Aphids will attack the variety but they do not increase on the plants at anywhere near the same rate as they do on susceptible varieties and the consequent virus disease is much less severe. In counts made at Lincoln, the average number of aphids per plant on Broad Leaf Essex was 2,300 while the count on the adjacent aphid-resistant variety was only 28. Furthermore, the variety is resistant to the virus disease, so even with a similar aphid population the effect on the plant is much less severe than it is on Broad Leaf Essex. The variety is not resistant to all species of aphids but only to the cabbage aphid (*Brevicoryne brassicae*). As this is the common aphid attacking rape, the susceptibility of the variety to other species is of little practical significance.

The next stage in the breeding programme, which is now well under way, is to produce a variety which is resistant to both aphids and club-root.

The Role of Cropping on the North Island Sheep Farm

It can be taken as read that the sheep farmer who has not grown crops is not likely to do so unless he has convinced himself that he stands to reap a net reward from the practice.

To embark on a cropping programme he will have to meet increased labour and capital costs which will need to be balanced against extra revenue likely to be derived from the programme.

A crop may be grown as a cash crop in its own right or with the objective of supplementing pasture in periods of shortage and thus increasing returns from stock. In the former category are such crops as wheat, barley and potatoes, and in the latter the brassica forage crops — choumoellier, rape, turnips and swedes. A cash crop may be grown to provide an additional source of income by cashing in on the fertility built up under grassland farming, but just as important to the overall return from the farm is the opportunity for pasture improvement which is provided by cropping.

It should be hardly necessary to mention the potentialities for pasture improvement provided by the greater use of pedigree strains of pasture plants bred by the Grasslands Division. The opportunity to obtain better pastures is provided by the crop, at least on that portion of grassland which is suitable for cropping. In the North Island, the area sown annually to new grass out of old pasture or previously cultivated land is 202,000 acres which is only 1.6 per cent. of the total area of sown grassland. At the current rate of pasture renewal it would take 60 years to replace the

present sown pastures of the North Island with strains of pedigree origin. It should be possible to speed up the process at least on that fraction of the grassland area suited to cropping. There are, of course, methods of introducing better strains into pastures without the use of the plough. In fact, much of the North Island sown grassland is unploughable and even where it can be cultivated it may not be suitable for cropping. But where it can be cropped the extension of a cropping programme should help to accelerate the present extremely slow rate of pasture renewal.

The introduction of more cropping into the farming programme, even cash cropping, should not result in any decrease in stock carrying capacity if that increase is gradual. In a farm survey carried out by the Department of Agriculture in Canterbury, it was shown that a threefold increase in wheat acreage over that of five years ago resulted in no significant decrease in stock numbers. The average area in wheat on the farms in this survey was increased by 54 acres, which brought the wheat area from 4 per cent. to 14 per cent. of the farm area. It is probable that this sort of picture would apply on most farms in New Zealand, for it is fair to say that very few farms are being worked to their maximum carrying capacity. Indeed, if forage as well as cash crops are included in the cropping programme, the improvement thus provided in out-of-season feed supplies should result in increased stock numbers.

By increasing the area of the farm in cash and forage crops the farmer widens his source of income, and at the same time stands to increase his stock carrying capacity by insuring against feed shortages and by the opportunities which cropping offers for pasture improvement.

Postscript

Farmers, of course, have a particular interest in agricultural research, first as those who may be able to "cash in" on the fruits of that research, and, secondly, as taxpayers who "foot the bill" for it. Many lines of research are difficult to evaluate in pounds, shillings and pence. For instance, how does one arrive at the value to the country of a new pasture strain? It may be obvious that its use increases pasture production, but to get that increase down to so many pounds of wool or butterfat is well nigh impossible. Or again, what is the monetary value to the country of a successful piece of research on the life history of an aphid? It may be exceedingly valuable research, for, as mentioned earlier, an aphid is a very important agent in the dissemination of plant diseases.

But there is some research that can be readily evaluated. An example is one already mentioned — the breeding of Aotea wheat. The monetary value to the country of the release of this high-yielding variety can be readily estimated, for the yield, acreage grown, and value per bushel are known. The yield of Aotea is at least 20 per cent. greater than that of Cross 7, the variety it displaced. In 1961, 161,000 acres, or 86 per cent. of the wheat harvested for milling was Aotea. A conservative estimate of the increased yield from the use of this variety is 1¼ million bushels, which at 13s 6d a bushel would be worth £840,000. Thus the extra value from Aotea in one year would have financed the Division's total research effort for the last 20 years.

DISCUSSION

Q : : *What percentage of Aotea wheat is spring sown, and do millers prefer this wheat for the quality of its flour?*
A : : Wheat is spring sown in the North Island, Southland and part of Otago. The percentage spring sown of the total acreage of Aotea is about 25 per cent.

The milling quality of Aotea is slightly inferior to that of Cross 7 (the variety it has largely replaced) and its baking quality is very similar.

Q : : *Why do North Island growers receive a 1s. a bushel more for wheat than South Island growers?*
A : : The price received by the North Island grower for wheat was fixed at 1s. more than that to the South Island grower to encourage wheat growing in the North Island and thus save transport costs.

Q : : *What are the merits of Festival wheat?*
A : : Festival is resistant to most of the races of stem rust in New Zealand, is of excellent quality and yields similar to Gabo in the North Island.

Q : : *What is the basis for resistance to aphids in rape? If the plant is unpalatable to aphids, will it not also be unpalatable to sheep?*
A : : The basis of resistance of aphid resistant rape is twofold. First, the aphids multiply on the plant at a much slower rate than they do on susceptible varieties, and, secondly, the aphid-resistant variety has some resistance to the virus transmitted by the aphids. The physical or chemical nature of the resistance is not known.

Q : : *Are studies still being continued on palatability of choumoellier?*
A : : No recent work on palatability has been carried out by the Crop Research Division where the certified varieties were bred.

Q : : *Is any work being undertaken to improve the yields of wheat in the North Island?*
A : : Wheats now used in the North Island have been introduced from overseas by the Crop Research Division and tested in collaboration with the Department of Agriculture. These include Tainui, Gabo, Festival, Gamenya and Mengavi. If wheats are to be bred specifically for the North Island, progeny testing and selection will need to be carried out there.

Q : : *Are attempts being made to make Gabo wheat more resistant to rust?*
A : : Not in New Zealand. Two Australian rust-resistant selections based on Gabo have been introduced — Gamenya and Mengavi.

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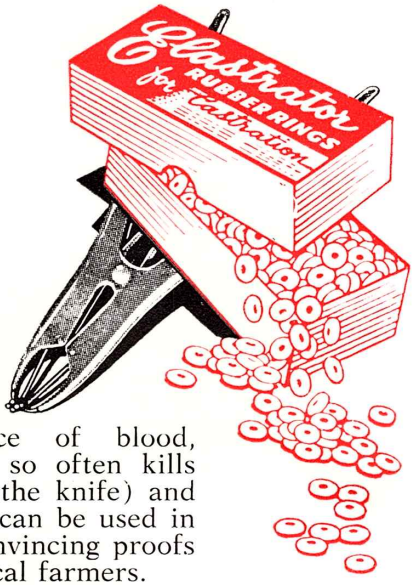

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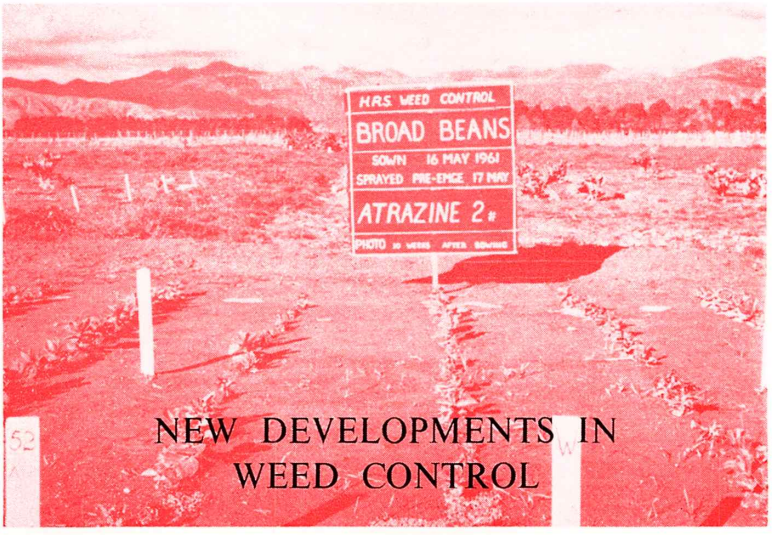

NEW DEVELOPMENTS IN WEED CONTROL

L. J. MATTHEWS*

GRASSES are the sheep farmers' worst weed problems. It has often been said sheep eliminate weed problems. This is not the case for grasses. Spectacular developments in weed control have been made in many directions, but the control of unwanted grasses has proved probably the most valuable aid to sheep farmers.

Pastures

Various weed problems are associated with the stage of development of sheep properties.

UNDERDEVELOPED PROPERTIES

Properties with a stocking capacity of 1 to 2 sheep per acre will have inferior grasses and low-fertility-demanding weeds, such as bracken fern, scrub and tutsan. Browntop and Chewings fescue form a close-knit sward and few weeds apart from bracken fern and scrub gain entry.

STOCKING CAPACITY OF 2 TO 4 SHEEP PER ACRE

Here inferior grasses limit production more than other weeds but the sward is not so compact. It is more open and gorse and blackberry are usually the dominant scrub weeds. Annual or bi-annual thistles such as winged, variegated, Scotch, nodding, welted, and slender-winged thistle may be present if not troublesome. Californian thistle may

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Browntop/Chewings fescue sward with a carrying capacity of ½ to 1 sheep per acre.

also be present. On light country storksbill or related species may be present. In some localities sedge species may be troublesome.

HIGH STOCKING CAPACITY

Low-producing grasses such as browntop and Chewings fescue are no longer limiting production, but barley grass, a high-fertility-demanding species, is the most serious weed problem.

The sward is more open, allowing free entry of annual and bi-annual thistles. The high-producing pasture species are more subject to dry weather, pugging, and insect attack, allowing a more rapid ingress of high-fertility-demanding weeds, such as barley grass, Californian thistle, and annual and bi-annual thistles.

Control

Weedkillers are of little value for the man with a low stocking density. Their importance increases as the fertility level is built up.

BRACKEN FERN

In 1953, 4-CPA was shown to be toxic to young fronds. Bracken fern is normally well controlled by increasing

Sward of illustration opposite "chemically ploughed". Lower half of photograph — fertilizer only. Upper half — fertilizer plus chemical weedkiller which killed existing sward. Carrying capacity of chemically treated sward is 4 to 6 sheep per acre.

grazing pressure and creating conditions not conducive to bracken fern growth. This is best done by sound farm management practices. Money invested in chemical weedkillers is more profitably spent on fertilizers in this case.

SCRUB

There is no satisfactory chemical control of manuka and kanuka. Mechanical agencies are the best forms of control, in conjunction with pasture management.

TUTSAN

No satisfactory chemical control exists for this species. Increase in land productivity in conjunction with fungal attack usually is sufficient to eliminate this weed.

GORSE

Gorse will exist in high-fertility pastures but it will not infest such pastures. Initially existing plants of gorse have to be eliminated. After this it is no longer a problem. On country too steep to be cultivated, the procedure should be

to burn, fence, oversow, topdress and mob stock. Regrowths should be spot treated with 2,4,5-T. Gorse control should not be commenced by spraying as this will add to the cost of development. Gorse should not be boom sprayed in new pastures as 2,4,5-T is very damaging to clovers. A rotary slasher should be used until the regrowths are so scattered that spot application of 2,4,5-T is worth while. Isolated plants or inaccessible clumps may be adequately controlled by fenuron pellets applied during the late winter months.

BLACKBERRY

Permanent control of blackberry depends on pasture improvement. On hill country too steep to be cultivated, an effective weedkiller would be of real value. Control with 2,4,5-T is disappointing particularly where blackberry has been chewed by goats. Effective control with one application is possible with 2,3,6-TBA. The initial cost is higher than for 2,4,5-T but complete control with one application may be expected. The disadvantage of the treatment is that clover establishment may be limited by the residual effect of the treatment for a year or more.

ANNUAL AND BI-ANNUAL THISTLES

The control of most annual and bi-annual thistles is possible without clover damage by MCPB. The thistles should be treated early when they are still in the seedling stage of growth and when soil moisture is high. In recent years, nodding thistle has become more widespread. It is more difficult to control than Scotch, winged and variegated thistle. Also, a narrow-leafed form of winged thistle is more difficult to control than ordinary winged thistle. Welted thistle is increasing in importance in a few localities.

If pastures are to be aerially sprayed, success is more dependent on good growing conditions than is the case for ground application. The thistles should be young and the soil moist at the time of application.

CALIFORNIAN THISTLE

The only effective method of control of this species is to put the pasture through cultivation. Discing or rotary hoeing should be used to cut the rhizomes of this species into short lengths. Regrowths may then be controlled in cereal crops, new pastures, or pea crops. If cultivation cannot be practised, temporary control is obtained with an annual application of MCPB, or more permanent control may be obtained with spot applications of amitrole or 2,3,6-TBA. The development of the "spotomatic" boom has made this possible.

BARLEY GRASS

If sheep farmers paid more attention to this weed in pastures than all other weeds they would not be wasting their time. The only programme that will meet with success is total eradication. Seed of barley grass does not remain viable longer than one season, but it is readily introduced in hay, and on stock and implements. To date, the only effective control is with 2,2-DPA ("Dalapon").

Farmers have requested a seed killer so that barley grass may be treated in the seed-head stage. To date it is possible to control seed only in the early development stage. Unfortunately, not all barley grass seed develops at the same period so that many sprayings are required. This fact annuls the value of seed treatment.

Inferior Grasses

If it is accepted that New Zealand's highest and best production comes from ryegrass/white clover swards, then inferior grasses such as browntop, Chewings fescue, and sweet vernal, limit production. The desire to replace these species has led to chemical ploughing. The full development of chemical ploughing may take years to become a reality. Success depends on:

(1) Sowing or drilling when there is ample soil moisture. A rough guide is that if it is dry enough to cultivate then it is too dry for chemical ploughing. Pasture mixtures in spring should be sown much earlier than normally practised after cultivation.

(2) On high-fertility land, a fallow period is not necessary. In cases where a fallow period is necessary during cultivation, trials have shown that the same length of period is an advantage in the chemical method.

Paraquat is an excellent grass killer and has no residual effect after application in the soil so that the crop or pasture may be sown immediately after spraying. To date, a comparable material is not available for killing broadleaved weeds and clover so this is a limiting factor.

Crops

Following cultivation, weed seeds have the same chance of germinating as a crop. Supplementary cropping on sheep farms would be more popular if effective weedkillers were available for specific crops.

FIELD BRASSICAS

To date weed control in field brassicas is not satisfactory. SMCA is helpful in eliminating red root and black nightshade, but it is not effective on grasses and fathen. There is no adequate control known for these weeds.

LUCERNE

If lucerne is to be weeded, it should be done with weedkillers rather than cultivation. Trials have shown that better success is obtained with chemicals than by cultivations. Most grass weeds are effectively removed with 2,2-DPA, and most broad-leaved weeds with 2,4-DB. Problem weeds such as chickweeds, speedwell, and established docks are still a challenge for the future.

Other Areas

DRAIN CLEARING

Chemical removal of weeds in drains offers many advantages; it is approximately one-third cheaper than mechanical weeding and it does not widen the drain. In the past, 2,2-DPA, amitrole and 2,4-D mixtures were used with good success except against floating and submerged aquatics. Control of most of these latter species is obtained with paraquat or diquat or a mixture of these. Paraquat is effective against grasses and diquat controls a wide range of aquatic weeds. These materials may largely replace 2,2-DPA, amitrole and 2,4-D mixtures for submerged aquatics as they are very quick-acting. Drains may be sprayed as late as 7 to 10 days before the onset of the winter rains.

PONDS

Stock watering ponds soon become contaminated with floating and submerged aquatics. The nitrogen level of such ponds is quickly built up by stock droppings allowing the rapid ingress of floating and submerged aquatics. Diquat either applied as a surface spray or as an injection is highly satisfactory. There is no danger to stock from the treatment of ponds, although it would be advisable to keep stock away for a short period.

Summary

New weedkillers are being developed continuously. Each new development allows for better specific control of weeds. There is much to look forward to in further developments such as chemical ploughing and more effective control of pasture and crop weeds.

DISCUSSION

Q : : *Is there any advance on the use of phenols for the control of weeds in peas?*
A : : Yes. There are materials now available that are much safer to handle and give very good weed control and are not dependent on critical climatic conditions as the phenols. The post-emergent treatment is a mixture of SMCA and MCPB applied not earlier than the 5th pea node stage. There are also some promising chemicals still under trial and these include such triazines as propazine and also the analogues prometryne and ametryne, which are applied before emergence of crop and weeds on finely worked up soil.

Q : : *Is marsh thistle likely to become a problem on hill country?*
A : : No. Its normal habitat is such that it requires fairly moist conditions, which are not normally found in hill country areas. Also it will not compete with improved pastures.

Q : : *In the control of undesirable grasses in lucerne, what damage can be expected from the use of 2,2-DPA ("dalapon")?*
A : : For the control of grasses about 4 lb active ingredient per acre should be sufficient, if applied about a month before the onset of spring growth when the lucerne is beginning to break dormancy. However, there will be an initial check to the growth for at least the one, or maybe two following cuts, but recovery soon takes place. Application at any other time results in a more severe and longer lasting damage, and allows the invasion of flatweeds to take place, with consequent lower yields.

Q : : *Is hormone dusting preferable to spraying for the control of wing thistle?*
A : : No. The spraying method is generally a more effective method of controlling thistles than the applications of hormone dusts, whether as such or in superphosphate mixes, although the latter type can and do give satisfactory results. The dusts are less readily absorbed and therefore require some surface moisture for penetration, and are more likely to cause damage to susceptible surrounding crops by drift than by spraying. Rainfall falling soon after dust applications is usually detrimental. However, during a top-dressing programme, with weather conditions favourable, the addition of hormone dusts for thistles would be advantageous. Dusts are usually 50 per cent. less effective.

Q : : *Are hormones effective against wing thistle in the winter when weather is frosty and thistles relatively dormant?*
A : : In the winter, the normal "phenoxyacetic" hormone type weed-killers used in established pasture, such as MCPA and 2,4-D, are effective, but the "phenoxybutyric" material MCPB for thistle control in new pastures is not recommended during the winter period. Thistles are susceptible to hormones, almost regardless of their growth activity, provided it is not a very dry spell when the thistle would be "toughened" up. Frosty weather does not appear to be detrimental to thistle control.

Q : : *Has there been any advancement in the use of 2,4,5-T and diesel oil for the control of barberry?*
A : : There has been further work carried out, but treatments such as fenuron and 2,3,6-TBA, although satisfactory, are far more expensive than the usual 2,4,5-T in diesel oil applied to cut stumps or as a basal treatment.

Q : : *What about the control of inkweed?*
A : : Inkweed is a difficult perennial to kill, and the only real control is obtained with the esters of 2,4-D in the seedling stage. Established plants are resistant to the normal hormones. The only promising material is 2,3,6-TBA at fairly high rates but this is rather uneconomic. Spot treatments of pelleted fenuron may also be useful. However, the best control to date has been repeat applications of oil-soluble 2,4-D or 2,4,5-T in diesel fuel oil.

Q : : *What are the economics of chemical ploughing to discourage inkweed in fodder crops and young pasture of the lighter soils of the King Country?*
A : : If the inkweed was present, this would have to be removed before any chemical ploughing technique. Here cultivation would appear to be the only answer, provided a good seedbed was obtained and active growth of the sown species. Fodder crops such as the brassicas that soon cover the ground would be ideal in discouraging any germination. Similarly, in new pasture, it would be essential to have the introduced pasture species cover the ground as quickly as possible and not be too heavily stocked thereafter. In the chemical ploughing technique the destruction of the turf would allow quick germination of the inkweed seedlings.

Q : : *Has paraquat a use in the control of barley grass?*
A : : Yes, but only in a limited sense. Paraquat has little selectivity in regard to grass species, and so would be damaging to the desirable ones such as ryegrass and cocksfoot as well as barley grass. In this respect 2,2-DPA ("dalapon") is far better. However, if plants that have missed spraying are in the fairly green seed-head stage and have not turned brown, paraquat will desiccate these plants preparatory to burning and viable seeds will not have been formed. If the spraying is done when the seeds are brownish, then viable seeds will still be present, whether desiccated or not.

Q : : *What methods are available for the control of chamomile on hill country?*
A : : The most promising treatment to date is diquat, applied at low rates to seedling growth. This does not permanently affect the grass-clover pasture and should be quite beneficial.

Q : : *Have trials been carried out on the spraying of weeds in a crop of choumoellier when it is about one foot in height?*
A : : Yes. The most effective post-emergent treatment so far is monochloracetate (SMCA). If this is applied when the choumoellier has at least 4 true leaves, then no real damage will be caused to the crop. The crop will be only about 6 in. high at the 4-leaf stage, but when 12 in. high it will stand fairly heavy rates. SMCA gives satisfactory control of most broadleaved weeds found in crops, with the exception of fathen and grasses. The most desirable rate would be about 15 to 20 lb/acre.

Q : : *What is the cost of improving poor hill country by chemical ploughing?*
A : : On an actual cost basis, chemical ploughing would cost approximately £15 to £17 per acre. This includes the aerial application and cost of chemicals, seed and fertilizer. The cost of the cultivation method varies according to district practice, but would be in the vicinity of £5 per acre.

Q : : *What effects would hormonized fertilizer have on native trees?*
A : : Hormonized fertilizers would have no effect on established native trees, and very little effect on very small seedlings at high rates which are not normally used.

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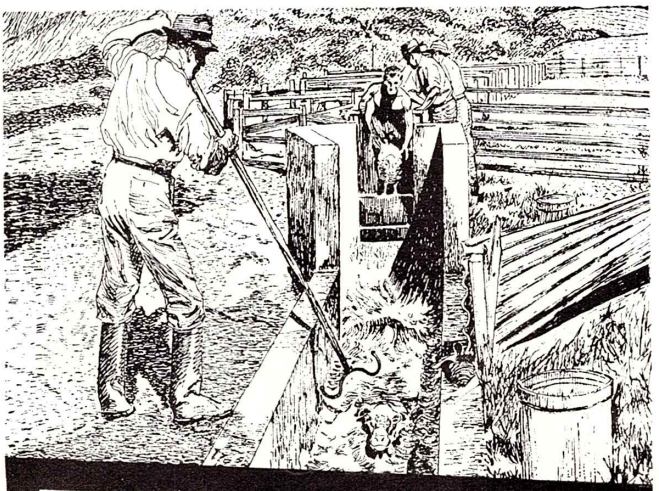

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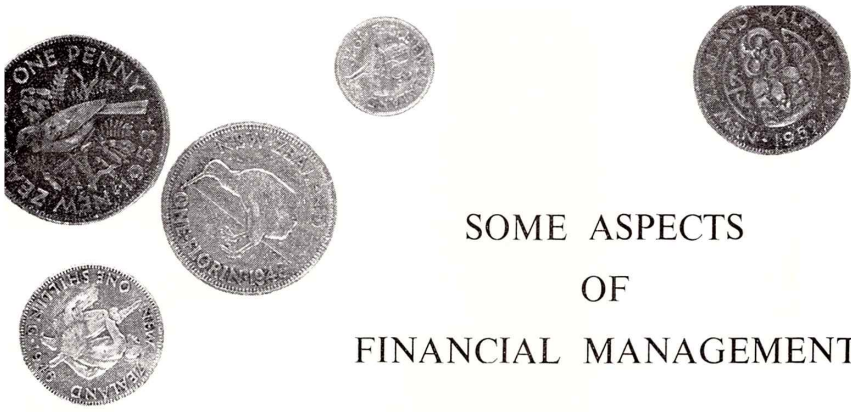

SOME ASPECTS OF FINANCIAL MANAGEMENT

N. WATSON*

UNDOUBTEDLY the main feature of the sheep farming financial scene is the reductions in margins of profit which have taken place since 1957 and which were particularly severe in the year 1958–59, and again in the season just concluded. Reduced prices, rising costs, drought conditions and credit restrictions have all had their impact. Because of these influences and the uncertainty as to the future, some farmers are faced with a difficult financial situation. This applies more particularly to those with small units, and to those who have recently acquired their farms and have high fixed commitments. It is the purpose of this paper to discuss some of the adjustments to management which may help.

At the outset, it is necessary to say that, with a subject such as this, it is not possible to give simple "recipes" which will have universal application. Circumstances of land, labour, capital and farmer's abilities and skills vary so widely that each case must be considered on its merits. The best that can be done is to provide some information and lines of thought which will help individuals to reach sound decisions.

Broadly speaking, the kinds of adjustments possible are of two classes: first, farm organization, and second, day-to-day management.

Adjustments to Farm Organization

Adjustments to farm organization refer to changes in the system of farming, in the kinds of production, and the organization for this. Two fundamentals impose some limitation in this respect. The first of these is the relative inflexibility of most sheep farms. In the hill country limita-

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tions arise from the simple fact of the land contour restricting mechanization and mobility and thus any high degree of intensity of practices. On the low and easy country, there is, of course, a greater range of livestock and cropping alternatives, but even here there are often limitations due to the particular climate, soils or size of farm factors. Existing systems of sheep farming have been evolved over the years to suit the class of land and the preferences and personal circumstances of the farmer concerned. Pastures and feed supplies have been geared up to this, as also have the farm layout, buildings, labour organization, machinery, and farmer's knowledge and skills. Many of these factors are relatively inflexible and it usually takes time as well as money to make changes.

The second principle deals with prices for products. A farmer is rightly very much concerned with the actual prices for his products as these affect his income and the value of his assets. However, it is the relative rather than the absolute prices of the various products which determine what it is most profitable to produce on the farm. In this respect, unless there is some really fundamental change affecting the supply and demand situation, the trend is for the prices of the various products to move up and down in sympathy with each other and thus, on the long term, to maintain fairly constant relative values. Within this broad trend, there are, of course, many short-term changes in relative prices and hence in the comparative returns from the different enterprises. The exceptionally high wool prices of 1950–51 and again, to a lesser degree, in 1956–57 were spectacular examples of this and the present relatively high prices of wheat and, perhaps, town milk, could well be further examples of unusual short-run price relationships.

When this market principle is considered in conjunction with that of the basic inflexibility of sheep farming, it is clear that it does not pay a farmer to try to adjust his organization on the basis of every short-term price fluctuation. If he does, the inevitable time lag will often result in his "zigging when he should be zagging". In other words, he may never catch up with the markets and constantly be on the wrong tack. Returns will inevitably suffer, too, from considerable disruption to the smooth and efficient working of the farm. After all, really efficient farming is difficult enough without attempting to chase every short-run market fluctuation.

All this does not, of course, mean to say that every sheep farmer has a perfect farm organization at present. Neither does it imply that significant long-term changes of one sort

and another do not take place from time to time which do require some change in organization if best results are to be achieved.

DIVERSIFICATION

Diversification is one of the things which it is fashionable to recommend to farmers whenever there is a fall in market prices. Most of these recommendations seem to be made from the standpoint that it does not pay to have all your eggs in one basket. It is true that the diversified farmer has somewhat greater protection against price and output fluctuations than does the highly specialized man. It is also true to say that mixed farming gives somewhat greater flexibility in switching the emphasis from one to another of the enterprises according to changes in market demands. However, protection from risk and uncertainty is not, in itself, sufficient reason for diversification. To be successful, any scheme for diversification must first be designed to maximize net farm income through combining enterprises which help each other to use available resources to best advantage. It is from this angle, primarily, that there is a case for a greater degree of diversification of some sheep farms today.

Possibilities for any particular farm should be considered from three main angles, namely:

(1) The land and other resources available.
(2) Comparative unit returns from the alternatives.
(3) How alternatives fit in (production relationships).

(1) *Land and Other Resources*

Everyone knows that most enterprises have specific requirements as far as land, labour, capital, and farmer's knowledge and skills are concerned. Thus a study of the situation on each farm will narrow alternatives down and indicate broadly which enterprises are worth considering.

In general, hill farms do not lend themselves to a greater degree of diversification than the sheep and cattle farming systems in common use. However, anyone on hill country who can improve his farm so that fat stock, as well as wool and store stock, can be produced, has a distinct advantage.

On low country fat-lamb places there are more opportunities, ranging from dairy cows, pigs or poultry, to cash crops such as wheat, barley, peas, small seeds, potatoes, mangels, pumpkins and even market garden crops such as onions. In the higher rainfall areas, alternatives are limited

to livestock enterprises and possibly potatoes, mangels or market garden crops. In the drier areas of Hawke's Bay, Gisborne, Wairarapa, and the Manawatu and Rangitikei districts, grain and small-seed crops can be grown.

The amount and qualities of the land available are the first consideration in deciding what to produce on a particular farm. Nevertheless, the situation in respect of the other factors also affects decisions. For example, some enterprises, notably beef cattle and, to a lesser extent sheep, have relatively low labour requirements per unit area of land used. Others such as dairying, but more particularly poultry, use much labour but relatively little land. Thus a farmer with much land but little labour will tend towards sheep and beef cattle. Another with very little land but more labour will tend more to intensive enterprises such as dairying, poultry and fruitgrowing. Because different enterprises have dissimilar capital requirements, the amount of money or credit available can influence choices of enterprises. Thus, beef cattle require more capital per unit area of the same land than do sheep, and sheep require more than dairy cows or poultry. Grain crops have the lowest capital outlay of all, apart from the machinery required, but on most low country sheep farms this machinery is already owned anyway or is available from contractors.

A farmer's knowledge and skill may be limited to sheep and cattle, and, although his land may be suited to diversifying with other enterprises, he may not feel capable of handling them. If diversification is sound in other respects, this lack of knowledge and experience need not be a deterrent. In the first place, much of the basic knowledge necessary to successful sheep farming has application whatever the enterprise engaged in. Secondly, there are sources of information available and time spent in learning about other enterprises may be time well spent. Finally, although some things can only be learned from experience, it is possible to insure against losses by keeping initial capital outlay on the new enterprise to a minimum and by trying it out on a small scale first.

(2) *Comparative Unit Returns*

Decisions on diversification also require that the alternatives be examined from the angle of comparative unit returns. This approach, while by no means giving a complete answer, does help to straighten out thoughts and indicate, in a general way, which of the alternatives is likely to pay best. The comparison can be made on the basis of

any of the units of input — that is to say, per acre of land, per unit of labour, or even per £100 of capital invested. However, comparative return per acre is usually best. Table 1 sets out comparative per acre returns for some of the more commonly used enterprises. It should be noted that this is based on the results from "typical" Manawatu fat lamb country under average efficient management with prices which in the opinion of the writer can reasonably be expected in the oncoming season.

TABLE 1: Gross Returns per Acre

Sheep — Fat lamb	5 ewes plus cattle	£17 10s.
Cattle fattening	200 lb beef	£11 10s.
Dairying	200 lb butterfat	£35
Wheat	50 bushels (6 months' use of land)	£35
Barley	60 bushels (5 months' use of land)	£28 10s.
Peas	40 bushels (5 months' use of land)	£32
Ryegrass	30 bushels (3 months' use of land)	£22 10s.
	20 bushels (3 months' use of land)	£15

These are comparative gross returns except that, in the case of sheep, the ewe flock maintenance cost has been deducted. Other costs must also be taken into account. These vary considerably from farm to farm for a variety of reasons and, although easy to calculate for particular farms, are difficult to discuss in general terms.

As a general rule, when comparing enterprises for use on a particular farm, it is only the actual "direct" costs which have to be reckoned with. Farm overheads are fixed anyway, and have to be paid, irrespective of whether the farm is diversified or not. Thus, interest or rent on the land does not come into the picture; neither does labour if the work can be carried out by existing permanent staff without other work suffering. Similarly, if tractor work is involved, as with cereal crops on a sheep farm which would have a tractor and gear anyway, then only added running costs are of significance.

Sound diversification spreads overheads over more units of production and is, in point of fact, one of the main arguments for it. There is, however, no point in trying to allocate these overheads between the various enterprises provided there is no undue competition with the main sheep enterprise for land, labour, and other resources.

TABLE 2: "Net" Returns per Acre

Sheep — Fat lamb						£17	10s.	–	£3	=	£14	10s.
Cattle						£11	10s.	–	£2	=	£9	10s.
Dairying						£35		–	£5	=	£30	
Wheat						£35		–	£12	=	£23	
Barley						£28	10s.	–	£13	10s. =	£15	
Peas						£32		–	£18	10s. =	£13	10s.
Ryegrass	30 bushels					£22	10s.	–	£10	10s. =	£12	
	20 bushels					£15		–	£9	=	£6	

As a guide, Table 2 gives comparative "net" returns for a fairly typical farm. It is based on the gross returns from Table 1 less the direct or variable costs. For example, the costs deducted for fat-lamb production are interest on capital livestock, ram costs, shearing, crutching, farm stores and veterinary supplies, additional to ewe depreciation already allowed for. In the case of the cereal crops, the costs are for cultivation, seed, manure, weed spraying, harvesting and selling costs.

Farmers cannot concern themselves only with comparative returns; comparative certainty of income and risks of losses must also be weighed. Historically, beef and wool markets are notoriously unstable and, although this is partly offset by the minimum prices schemes now in operation, both these products are relatively risky compared with dairying with its annual guaranteed price. Wheat has a guaranteed price of 14s. 6½d. a bushel, but under the heavy land conditions of the Manawatu, wheat is not as reliable as barley which has no fixed price. Peas are risky to produce but have the advantage of product flexibility and can be grazed by lambs or other stock if not harvested. Ryegrass is in the moderately hazardous category from both the production and marketing angles but, if lost as a seed crop, may still return something as hay. White and red clover are high return crops but, in this area, are so uncertain as to be more in the nature of windfalls rather than normal income.

A further consideration of lesser importance in combining enterprises is distribution of income. None of the enterprises listed are good in this respect except dairying and poultry. However, combinations of sheep, cattle and cash crops often give a good spread of income and this can be a further advantage of diversification.

(3) *How Enterprises Fit in*

The third angle to be considered when combining enterprises is how they fit into the general scheme of things on the farm. Some enterprises compete or conflict with others in the use of resources. Thus, if a dairy herd were introduced to diversify a sheep farm, it would be competitive in that it would displace the sheep to some extent in the use of land and labour. Having regard to the substantially higher returns per acre from dairying, this could, in some circumstances, be a good thing. However, where labour is limited, or where the proportion of good land available is small, greater returns generally accrue from sheep.

Not all enterprises are competitive. Some work in very well, giving added net farm income without the need for any reduction in the main enterprise. One way in which an enterprise can do this is to utilize a by-product of the farm which otherwise would have little or no value. This sort of enterprise has no application on straight sheep farms but classic examples are found in pigs and poultry on dairy farms.

Another way in which an enterprise can help is not so much to give returns in itself, but to assist the returns of another enterprise. A familiar example is that of cattle on North Island sheep farms. Per acre or per unit of suitable feed, cattle do not return as much as sheep. However, they do give useful returns in themselves at low cost, and, more important, cattle are necessary as grazing and pasture production "tools". Yet again, cattle help in handling risk and uncertainty by providing something to vary on according to seasonal conditions. For these very sound reasons, an optimum ratio of cattle to sheep must be maintained on hill country. At the same time, cattle tie up very large sums of money and, if this commodity is in short supply, there is a strong temptation, and sometimes outside pressure, to reduce cattle numbers below optimum. This must be resisted.

On some fat-lamb country, use can be made of another complementary relationship, this time between the livestock, which are fertility building, and cash crops, which are fertility depleting. The fertility building process on some of this land, under grassland farming, has reached a stage where it is difficult to utilize it fully using sheep and cattle. Cash crops provide a means to this end.

The third way in which additional enterprises can help is to use the land and other resources at a time of the year

when they are not fully utilized by the main enterprise. This concept, together with the complementary one just discussed, has considerable application in diversifying fat-lamb farms in districts of the North Island where cash cropping is possible. The fat-lamb schedule is now so rigged that the return from a light to medium lamb does not differ greatly from that of a heavier one which generally takes longer to produce. It is therefore now economic to draft lambs earlier than was previously the case. In conjunction with this, it is now known that lambs can be weaned much earlier than hitherto was thought possible. Application of these practices, earlier drafting and weaning, assists in releasing more of the farm for cash crops of small seeds and hay if not also for cereals.

It is possible to go a step further than this and dispose of all stock in the early or mid-spring. Thus, ewes and lambs may be sold "all counted" or, if dry sheep are farmed rather than ewes, these may be sold off the shears in September or October while prices are at their peak. The land can then be used over the spring and early summer for potatoes, mangels, cereal crops, small seeds, or any combination of these. In effect, this approach enables two "crops" to be taken off the same land in the one year thus, in some instances, more than doubling income.

An example of this is given in Fig. 1. This diagram represents an actual 200 acre farm with a very fertile soil and low rainfall conditions. During the autumn, winter and early spring, the whole area is in ryegrass/white clover pasture stocked heavily with sheep — usually wether hoggets — and a few weaner cattle. As the feed comes away in the spring the livestock are "tightened up" and 20 per cent. of the farm is ploughed for peas and potatoes and resown to pasture in February. The sheep are sold "off the shears" in the latter part of October and with this the remainder of the farm is shut up for ryegrass seed with a small area of white clover seed and some hay. Following harvesting, with the whole area once more available for grazing, restocking is effected.

This is an extreme case of the application of the principles earlier discussed. Such intensity of diversification is possible only with very fertile, free-draining land and then only if the management and husbandry are of a high order. However, the same ideas can be applied to a lesser degree on land of lower fertility, provided the climate is suitable. Crops other than these can be used but peas fit in well with ryegrass seed owing to their effect on fertility and the very high ryegrass yields resulting in the maiden year.

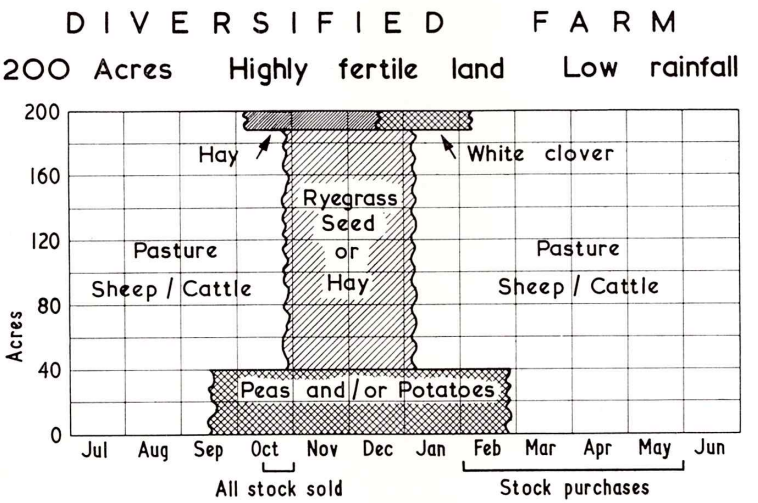


Fig. 1.

When diversifying in these kinds of ways, it is necessary to consider the effect on labour as well as on land use. Problems can arise in getting the work done. For example, if farmers grow wheat on Manawatu fat-lamb farms it has to be drilled in August/September and this clashes with lambing and docking. This may not be insurmountable on the larger farms where there is "divisibility" of the labour team, but on the one-man farm it is impracticable unless contractors, with all their limitations, are employed. In these circumstances, barley fits in much better since it does not have to be drilled until the end of October or even later, when sheep work is relatively slack.

OTHER ADJUSTMENTS TO FARM ORGANIZATION

Diversification cannot successfully be applied to all sheep farms. What other organizational adjustments may be necessary? Space does not permit much further discussion. However, pertinent questions to be asked include the following. Is the property really sufficiently stocked to enable full utilization of pastures and the maximum return for money spent during recent years on superphosphate, extra fencing and water supplies? Much money has, in fact, been wasted, particularly on superphosphate and oversowing by not stocking up sufficiently. One of the reasons for failure to stock up is the risk of getting caught out in a bad season, even although this bad year may occur only

occasionally. Where this risk is a real one, the question should be asked whether it is possible to insure against it by, for example, having extra hay in reserve and/or by organizing some form of flexible stock arrangement which will enable "lightening up" without loss if the pinch does occur. The farmers who make most progress are those who run reasonable risks and who also cover themselves when it is practicable and economic to do so.

Another question which may usefully be asked, in some instances, is whether all the machinery in the shed is really earning its keep. If sufficient useful work cannot be found for it, would it not be better to cut losses and dispose of some of it while it still has some value?

Then there is the very big question of labour organization which can only briefly be touched on here. Are the present arrangements as to classes of labour used the best? Is it possible to find quicker and easier methods of doing the various jobs? Can the farming system be modified, or work planning improved, to avoid undue peaks of seasonal labour peaks at times, and wasteful slack periods at others? Can efficiency be increased by the use of more or better schemes of incentive bonuses?

Adjustments to Day-to-day Management

There are two ways of adjusting day-to-day management. The first is to reduce costs and control expenditure and the second to increase efficiency and output.

The question of reducing costs and controlling expenditure introduces the idea of budgeting, some form of which is essential in modern farm management. A full discussion is not possible but two useful basic ideas when budgeting costs within a given framework of policy, organization and probable returns are:

(1) Mentally separate farm costs into those which are essential and those which are either non-essential or just merely desirable.

(2) Superimpose over this a critical examination of all non-essential expenditure so as to use available surplus funds where they will give the greatest, most immediate, and most certain returns.

Essential costs include:

(a) "Fixed" overheads, such as rates, interest and rent, which have to be paid and cannot ordinarily be varied by the farmer.

(b) Costs essential to a given production programme. For example, if sheep are farmed, shearing is an essential cost. So, too, are such items as woolpacks, crutching, minimum labour and machinery requirements, and the like. It is true, of course, that some of these costs can sometimes be varied according to the methods used as, for example, shearing by contract or on casual per 100 rates. Nevertheless, they are essential costs in the broad sense.

Non-essential or just desirable costs are those which the farmer would like to include but which can, if needed, be omitted during the particular year. Included here are certain types of repairs and maintenance, most developmental items, and many items of personal or family expenditure.

In order to discuss the application of these two ideas when budgeting, it is convenient to group costs under five rather arbitrary headings, namely:

Overheads
Running or Working Expenses
Development costs
Taxes
Personal drawings.

OVERHEADS

Overhead costs are the so-called fixed costs, such as interest or mortgage commitments, rent, rates, insurance, and certain parts of depreciation. In a way, too, wages required for efficient running, together with certain other production costs, are overheads in the sense that they are "essentials" as outlined earlier. Depreciation is not a fixed commitment in the ordinary sense when considering current expenditure, as it does not have to be met in cash each year and can therefore be overlooked on the short run. In point of fact, it seldom pays to put money aside for depreciation as a regular practice for the simple reason that the "opportunity" cost of doing so is too high — that is to say, the money will give a greater return if used for something else. Interest return on farmer's capital/equity in the farm and "wages of management", although useful concepts, should not be considered as fixed overheads. Rather than drawing the money out of the farm, it may be wise in certain instances to "plough" it back.

RUNNING OR WORKING EXPENSES

Running or working expenses cover all the costs incidental to production other than overheads. Included here are certain labour costs, stock replacements, feed produc-

tion costs, freight and transport, all "direct" livestock costs, repairs and maintenance and sundry items — accountancy, telephone and mail, etc. Most of these are in the essential category, but some economies may be possible and some points need discussion and emphasis.

Maintenance of basic ("capital") livestock numbers and quality, at the optimum level is something which must come ahead of all other expenditure, including personal drawings — the farm must be stocked to its capacity. However, savings may be effected by taking steps to minimize annual wastage from disease and misadventure. This is essentially a matter of good general husbandry, but intelligent use of veterinarians, vaccines and medicines can assist.

With fat-lamb units, it is essential to keep ewe replacement costs down to a reasonable relationship to income for the year from wool, fat lambs and cast ewes. A useful strategy here is to ensure that the wool clip, as well as the majority of the lambs, are sold before replacement ewes are purchased.

With the majority of farms, maintenance applications of manure must rank almost as high in the order of priorities as stock replacements. Basic seed requirements cannot be cut in quality or quantity, but where regrassing is contemplated the real need for it should be examined closely. Regrassing costs are very high and will pay only if the extra feed is fully utilized, particularly over the spring period. Also, of course, there are other methods of pasture improvement than that of regrassing and these may be cheaper and better in particular instances.

Conservation of truck and tractor fuel and oil and other vehicle running expenses is a consideration tied with labour costs and general efficiency and the need to save time in the various operations. Thus, although these machine costs must be watched, especially where finances are limited, it should not be in such a way as to represent false economy. It is necessary to recognize that this is a machine age, and farming is now well out of the self-sufficient stage.

Opportunities for savings on such items as shearing, dipping and farm stores are few but each item should be examined closely to prevent money leaving the farm unnecessarily. In these days of advertising and pressure salesmanship, where advantage is often taken of human weaknesses rather than human needs, a farmer must develop an analytical approach to his expenditure, coupled with a "sales resistance". In particular, he needs to look carefully at new gadgets and chemicals in an endeavour to

separate those useful to him from those which are not. Especially should he avoid buying things just because it is fashionable to do so.

Expenditure on repairs and maintenance is not directly concerned with output. Consequently, although the aim should always be to maintain farm improvements and machinery in good order, expenditure on this can be heavy or light in any particular year, according to the income and taxation outlook.

DEVELOPMENT COSTS

Many young farmers have rather romantic ideas on farm development. In point of fact, a development complex can be a highly dangerous thing in a young, inexperienced, and financially limited farmer. The first essential is to farm the property efficiently at its present capacity. To superimpose a development policy of any magnitude over this is simply to add very greatly to the difficulties involved. Nevertheless, there are many farms where effective management has been achieved and where surplus money and other resources are available and, in these cases, progressive farm development is likely to be a much more rewarding course of action than investment off the farm or any other alternative. In allocating money, and other resources, for this purpose, the completion of projects already under way must have top priority. For example, a drainage scheme may have been started or an area of scrub cut with a view to regrassing, and it is essential to complete this work in order to benefit from it and save the capital already expended. After this, if there is still some capital available for further development, it must be used to best advantage.

In this respect taxation must be considered but only as a secondary factor to sound farm practice. On the whole, funds used on extra manure, improved water supplies and more or better livestock, are likely to give a greater return than investments in fences and buildings or repayments of liabilities, unless the latter are excessively high. However, much depends on farm circumstances and it is a "law" that production (and profit) stems from a balanced combination of inputs and therefore it is often necessary to spread available resources over a number of items rather than concentrating solely on one. Thus, for example, development from using superphosphate alone is seldom practicable; with the extra manure, must go clover seed, the necessary stock and grazing management, and perhaps more fencing and improvements to water supply. In these circumstances, where resources are limited, tackle a smaller area and handle it well rather than attempt too much.

TAXES

In spite of reduced incomes it appears, rather surprisingly, that some sheep farmers still have a taxation problem. This cannot be minimized merely by engaging an accountant to do the job; the farmer must himself initiate the approach to the taxation problem. He can do this only if he has a working knowledge of taxation regulations and is right "on top" of his financial affairs. Furthermore, it is not sufficient to leave the matter to the end of the year when it is often too late to make the necessary adjustments. Assuming a balance date of June, it is most important each year to make a formal review of financial progress in February or March. By this time most of the farm income is either in hand or clearly in sight, also much of the essential expenditure has been met. Equally important, sufficient time remains to adjust plans to best advantage. An accountant with his specialized taxation knowledge may assist at this stage.

A further point, necessary to successful management of finances, is to insist that the accountant supply accurate advice early in the year as to the amount of tax payable in that year. This can only be done, of course, if the previous year's books of account are completed and this is a point, in itself, on which the accountant may need some encouragement.

PERSONAL DRAWINGS

Personal drawings are indeed a personal matter. However, it would appear that since farmers are not manufacturers and must sell on the open market, the amount drawn must bear a reasonable relationship to the earning power of the farm after allowing for other essential expenditure.

INCREASING EFFICIENCY AND OUTPUT

The most effective way of adjusting to reduced prices is, of course, to increase output. This, if economically effected, gives added returns while, at the same time, reducing average unit costs of production by spreading overheads over more units of output. The question that arises is how to do this when funds are limited. The need to use such money as is available in the best possible way has already been discussed. The same principle applies to labour which is just as often the limiting factor as capital — perhaps more so. Time spent on stock work and on the necessary observation and thought as to grazing management and stock feeding will invariably pay good dividends and, moreover,

costs little in monetary terms. On the other hand, labour expended in putting up new buildings, fences or "flash" stock yards, or even in breaking in new land, usually yields relatively low and slow returns and, also, often has high costs for the materials to go with the labour.

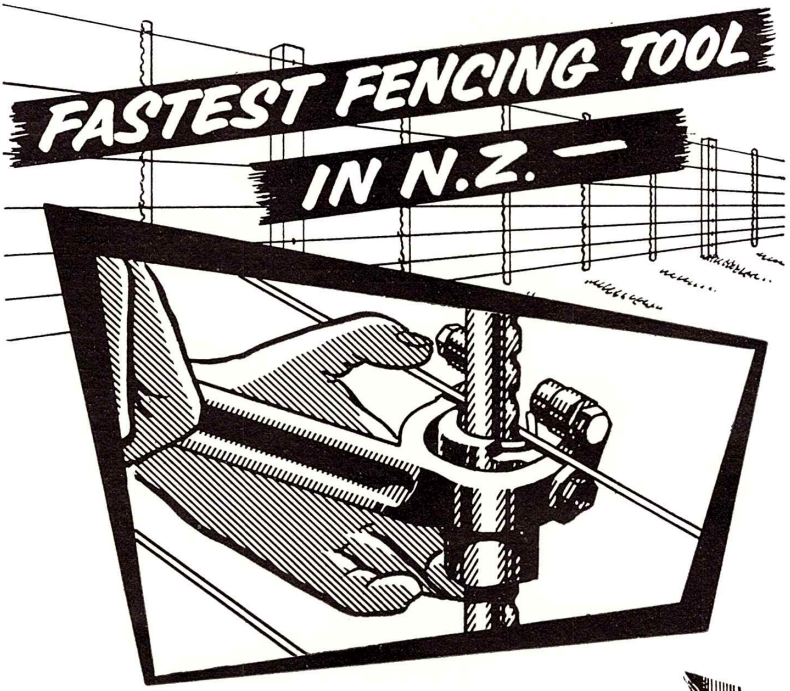
Finally, there is the need for a farmer to do all he can to improve his personal management efficiency. This again is something which has little monetary cost but which can have big rewards. Farm management comprises mainly decision making. This includes acquiring the basic ideas and the knowledge; sorting these up in relation to the particular problem and circumstances on the farm; making the decision and acting on it; finally, carrying the risk and responsibility. Sound decisions, therefore, depend partly on judgement and experience but also, in fairly large measure, on the amount of mental and physical endeavour made.

This, then, is the ultimate decision to be made; on which a farmer's income will depend.

DISCUSSION

Q : : *Do the gross and net returns for fat lamb farming given in the tables include returns from cattle?*

A : : Yes. The figures are based on the returns from 5 ewes per acre together with cattle on the basis of 1 beast to 20 to 25 ewes. Gross return from the cattle is assessed at £7 to £8 per head which is equal to 30s. to 40s. per acre. "Direct" costs in farming the cattle comprise mainly interest on capital invested.



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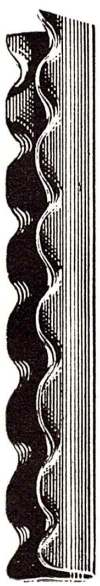

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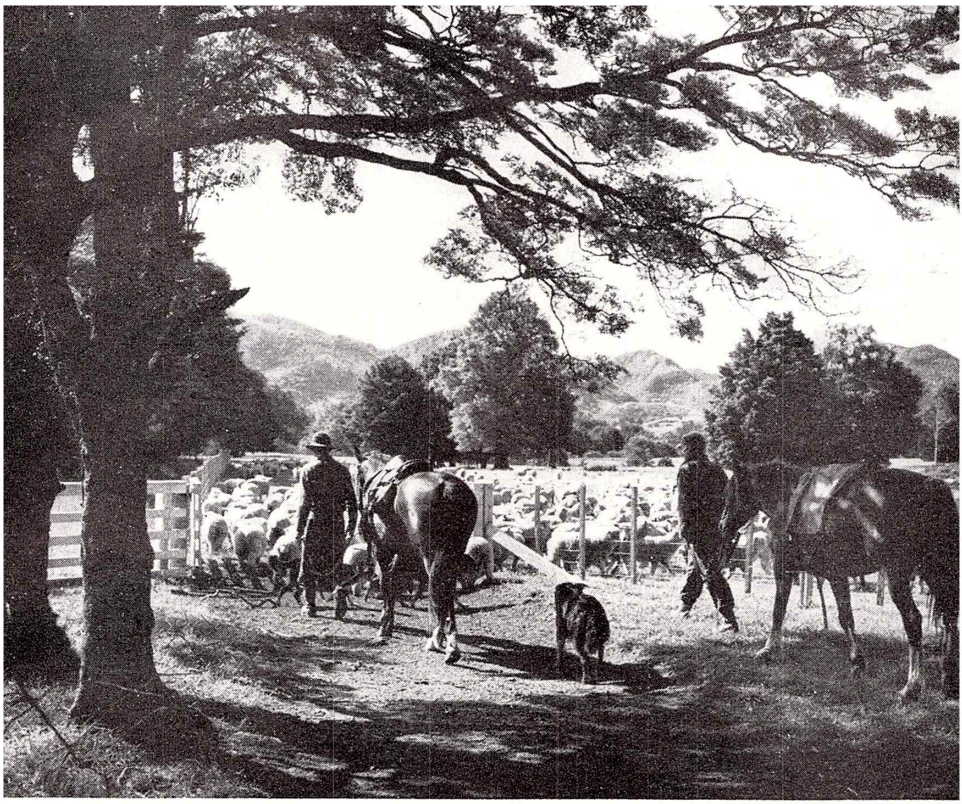

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SOME THOUGHTS ON FARM LABOUR PROBLEMS IN NEW ZEALAND

JOHN C. ANDREW*

NEW ZEALAND will remain dependent on primary produce for many years to come to earn sufficient overseas exchange to finance overseas purchases of goods and raw materials. The development of primary and secondary industry must of necessity be complementary and be planned on a long-term basis free of inter-industrial and inter-political prejudices.

It is with this object in mind that the writer has drawn up a two-pointed plan to meet the supply of farm labour for development in primary industry. New Zealand must aim at a 6 per cent. annual increase in production, which, maintained for fifteen years, would mean an additional £300 million of overseas income annually. Such a goal is neither absurd nor impossible. The resources and skills are

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available and, given the labour, conditions of growth, plus determination to overcome marketing problems, it can be achieved.

Basically, the labour problem is one of a drift from rural to urban areas where conditions of employment, pensions, education, home ownership and self independence of the individual are very much better.

It is essential that primary industry regain its fair share of the labour force to maintain a programme of increased annual production to sustain the nation's standard of living. A great change in attitude towards the agricultural labour force must take place. Primary industry must be prepared to meet the labour market on the same terms and conditions as its industrial and commercial counterparts. Many farmers believe that this can be done by economic depression alone, but such a policy is only short-term, for when conditions improve labour again flows away from the land and secondary industry makes greater strides at its expense.

A scheme is necessary which will be able to withstand economic fluctuations of agricultural products, give permanence during times of recession, and stability from urban drift in times of high prices. In New Zealand, farmers are often confronted with the paradox of objecting to high taxation on the one hand, and on the other demanding more financial support from the Government. Any scheme must, therefore, after its initial establishment, be self-supporting and also be capable of repaying the money used to establish it, and thus not become a perpetual drain on the national resources.

The two schemes proposed as a solution to the labour problem are as follows:

(1) A rural farm settlement plan or village system to suit closely-settled rural areas.

(2) A farm bursary plan to suit, in the main, those areas which, because of distance and geographical layout, would make it uneconomic to draw labour from a central point daily.

Each of the schemes is complementary one with another and each is designed to attempt to achieve a degree of permanence, stability and financial independence.

The economic conditions pertaining at any one time have been equalized so that a long-term project can be put forward. In doing so it is fully realized that this is not a solution in itself, but rather a basis on which to work and from which some sound long-term policy could be evolved.

The Rural Farm Settlement Plan

This is designed for the man of limited ambition, who wants a secure job, to own his home, be provided with a pension in later life, and enjoy the benefits of an urban community in a rural setting.

THE PLAN IN BROAD OUTLINE

An area, or district with a radius of about ten miles is selected. This area, treated as a new factory of like potential, would be on the outskirts of a large urban area. Here is formed a District Farm Settlement Authority and a site for a settlement, preferably on an existing centre, is chosen.

A complete and comprehensive survey of the development potential, together with the labour, finance and material requirements, for a period of 25 years is made. This will determine the size and development rate of the settlement. There are several organizations capable of carrying out this task, for example, the Economic Service of the Meat and Wool Boards, or the Labour Department, to mention but two. Since an endeavour is being made to utilize the industry's own resources, the first-mentioned body is probably the obvious choice.

The settlement is planned on the same basis as a suburb resulting from an industrial enterprise, and with similar conditions — electricity, primary and secondary education (initially children attending secondary schools would probably be transported by bus), drainage, recreation and finance. (Where a settlement is established in an existing community, many of these facilities would already be available.)

Finance is important as at present a farm worker cannot borrow money or capitalize his family benefit outside a borough or town board. If this was remedied, a potential worker could buy a section, raise money on it, capitalize his family benefit and build a home of his own, at the same time becoming a ratepayer and an integral part of the rural community.

The initial purchasing of the land and subdivision could be done by the local authority. This could be financed through the State Advances Corporation or the Government Life Insurance Office. It is envisaged that a special subcommittee and not necessarily councillors of, sav, the local county would constitute this authority. Thus duplication of an already top-heavy system of local bodies would be avoided.

The State money invested in the scheme would be secured against the land controlled by the authority — which would have power to strike a rate to recoup this if need be through the rating system of the parent body. Such a system gives security to public money; maintains maximum interest by land owners; and gives stability in times of economic recession.

The sale price of sections would be at cost. This would provide sufficient money to cover eventually the repayment of the money advanced by the State.

The sale of his house by a farm worker would operate in the same way as in urban areas, with the difference, however, that in the initial stages the authority might have to, in fact, guarantee his equity in order to give stability to the settlement. This might have to be met by rate, but, again, this would maintain owner support to a maximum.

Any farmer would be free to build new or utilize existing houses on his farm, but he would still be liable for any rate struck by the authority. As this scheme is designed on a long-term basis for additional labour rather than redistribution of the present force, plus the utilization of existing capital resources, existing houses on farms will always have an important role to play. In any community there are those who prefer to live on the job and not be saddled with the capital cost of home ownership. Any farm cottage now in existence could, with the approval of the authority, be brought into the scheme as a rental house and would be occupied on a similar basis to its counterparts in the town.

In times of economic recession, the authority, as a local body, would have power to draw money from the Labour Department to maintain employment. The putting off of men would be investigated in every case and relief money would be used to retain this unit of labour as a working unit in the rural community. This would maintain the rural development of farm lands and achieve stability. As an example, in 1958 in one area in the Wairarapa, a number of men left a certain country area and were re-employed by a local body subsidized by the Labour Department in the town. These men then returned to the same district by the day to carry out the work of that organization. Although slightly different from the work originally done, the net labour force in the district remained constant. The net loss was a shorter working day, a daily journey of 60 miles and several empty houses, for which individuals and taxpayers alike paid their share.

A pension scheme would be introduced similar to those operating in secondary industry. It would have to be

coupled to the National Provident Fund to put the farm worker on the same basis as those in industry and the Civil Service. Once the farming industry had been relieved of the burden of housing its labour, it could, without strain, support such a scheme. This need not be run by the authority, but it would be obligatory on all those employing labour within its area to see that their employees belonged to it.

The Farm Finance Assistance Bursary

This is designed for those of more than average ability whose aim is farm ownership, who have not the capital to achieve it, but whose endeavour and capabilities deserve such a reward, provided they are prepared to assist in the staffing of the industry in less accessible areas during the tenancy of the bursary. Such bursars would, where possible, be placed outside farm settlement authority areas, or districts not suited to such an arrangement. The selection board would have power to waive these provisions if it thought fit. The scheme is not designed to assist further those who already have substantial capital resources. It is applicable, with modification, to sheep farming, dairy farming or other services allied to farming.

PLAN IN BROAD OUTLINE

The Bursary is open to all those who have (a) A capital sum of £1,000; (b) Carried out three years' satisfactory farm work; and (c) Reached the minimum age of 20 years.

Each applicant would be judged on his merits before a selection board set up for the purpose.

The bursary would be tenable for 10 years and each successful applicant would agree to go where placed and follow the practical course laid down from time to time by the board.

It is not envisaged that the board would direct labour but rather it would channel experienced men into areas where present labour is hard to get and where future land development is likely to take place.

Each applicant would be up-graded by one unit annually after a satisfactory year's work. A year at an agricultural college would constitute an up-grading year. After six years each applicant would be expected to fill a position of responsibility either in a head shepherd or managerial capacity.

Where a bursar had not made satisfactory progress, the board would have power to review the case. If it was obvious that the bursar was not suited to ultimate farm

ownership, but was more suited to enter one of the trades servicing farming, and if the bursar was agreeable, the bursary would be converted to a farm servicing bursary to be payable at an earlier date and so establish the bursar as an agricultural contractor, transport operator, etc.

Conditions for termination of a bursary before its completed time would be at the discretion of the board. However, some financial loss must be sustained by those who withdraw from the scheme other than as a result of extenuating circumstances.

Each applicant would lodge with the State his capital of £1,000 for 10 years. He would:

(a) Receive interest on his capital sum at current interest rate.

(b) Add to this capital sum each year, out of his own savings or income, £200 on which income tax, if applicable, would be paid.

(c) Have accrued to him each year the sum of £200 being the value of the bursary which would then be added to his capital sum.

(d) Receive all interest on this capital sum free from tax except as stated in (b).

With interest at 5 per cent. a capital sum of approximately £6,800 would have accrued over a ten-year period. This is sufficient at present prices to give a bursar a 25 per cent. equity in a 1,000- to 1,200-ewe unit plus 50 per cent. equity on the livestock. The interest rate, bursary and yearly contribution must be so set as to achieve for the bursar at the end of 10 years this ratio of equity otherwise inflation will defeat the object of the bursary.

The capital sum invested in the State by the bursars would be required to go into a special land development fund for new development projects over the country. To run the scheme, £1,500,000 would have to be set aside annually from death duties, gift duties and stamp duties derived from farming estates. This would, in effect, channel back to the land a portion of the industry's annual capital loss, assist in the refinancing of individuals, and accelerate land development. It would also draw into the industry men who would otherwise, owing to the high capital cost of a farm, see no future in the industry for them.

The scheme would produce 750 men annually of good quality and experience to go into areas where it is difficult to obtain labour, on the understanding that they get something worthwhile at the end of it.

At the end of each ten-year group, a total of approximately £11 million would be available for additional land development. This, coupled with the present programme of land development, would really produce spectacular results.

It is not envisaged that all bursary entrants would attain farm ownership, as in any scheme there is always wastage and falling by the wayside. It is reasonable to assume that, with 750 bursars, the pattern could possibly be as follows:

Total bursaries	750
Normal wastage at 2 per cent. per annum	150
Bursaries converted to services servicing farming	150
Farms required for bursars and produced by bursars' development capital	300
Farms purchased by bursars on the open market	150
	750

The capital cost of developing a farm has been assessed at £30,000, allowing £10,000 as working profit over 10 years of development.

It seems reasonable that 150 farms could be purchased out of the 5,000, more or less, which come on to the market annually of which 2,500 are dairy and 1,500 sheep units.

Conclusion

The two schemes are a genuine attempt to produce a basis for the possible improvement of the present farm labour position. It is, however, idle talk and a waste of time to pursue this line of thought if New Zealand is not prepared to develop to the full her main exporting industry. Here, it is appropriate to quote P. F. S. Otter, Chairman of Philips Gloeilampenfabrieken, the Dutch electrical colossus, who, when dealing with the same problem, said, "The solution lies in long-range planning, not sterile, perfectionist planning with no room for human factors and social feelings, but planning with the knowledge that the only constant thing in this life is change. I have no faith in a plan drawn up by a team of theorists. In order to fulfil its function a plan must be regularly renewed and readjusted, it must be continually filed and polished. It must live. That can be achieved in only one way: Create decisive moments." The primary industry must know where it is going and where it can reasonably expect to be at any point in time in the next decade.

It must stop its present policy of farming off-the-cuff year by year.

It must not be so bogged down with the problems of the present that it has no time for long-range planning.

It must accept as its aim nothing less than a 6 per cent. annual increase in primary production.

It must have the confidence of, and be able to take along with it, the secondary manufacturers of New Zealand.

It has the resources and skills; it must now recreate the conditions of growth, facing clearly the challenge of new markets.

It must have leaders who are prepared to get out in front and give farmers this lead — men who have the complete support of farmers and with sufficient respect from the whole community to see that the road is clear ahead and that farmers will achieve their aim.

It must not lose sight of reality. New Zealand has men capable of leading provided they are given the support they need. The challenge is not as colossal as it might seem.

Compare the situation that existed in the 1890's and the development that followed in the next thirty years owing to the advent of refrigeration in 1882. Consider the task then, with few roads and poor communications, half of the North Island under virgin bush, no mechanized transport, little scientific understanding of soil and stock problems and no organization for handling or distributing frozen meat and dairy produce to the other side of the world.

Are not the challenges that faced our fathers and grandfathers much the same as those of today when the E.E.C., new markets in South-east Asia and the rest are considered? It will be necessary to apply new techniques both here at home and abroad in meeting these challenges. Surely this country is better equipped today for the task than our forefathers were 70 years ago.

If this challenge is not accepted what is the alternative?

DISCUSSION

Q : : *Does not Mr Andrew feel that if a labour pool were established near to town, then that labour would prefer to work in town?*

A : : It is not envisaged that such a settlement be established near a town. Those farmers who at present live close to a town already enjoy the benefits outlined in the paper with the exception of, say, a pension scheme.

These settlements would therefore be established so that their extremities would not be closer than ten miles minimum to a town. This means that any person who wants to work in that town has to travel first to the boundary of the settlement and then the extra miles to the town. He would have to travel considerably more miles daily than any other person in the settlement. Here again, the essential point of siting a settlement depends on a sound pre-planning survey.

Q : : *What about educational facilities in these labour pools?*

A : : A settlement would be, as far as practicable, self-supporting. Primary education would present no problem apart from the expansion of existing facilities if the centre of the scheme was based on a local centre. Secondary pupils may initially have to travel by bus. It is emphasized, however, that following the economic survey, and early in the planning stage, an expected growth rate would be established. This would then lay down, within a flexible framework, the various steps that would take place. In latter stages of development, the secondary department of the former district high school, with a difference, is envisaged. Such a secondary department would form part of a larger, parent college, thus allowing a free interchange of specialized staffs. It is easier to transport individuals than classes. Where facilities at these departments did not cater for specific needs through lack of technical equipment, the class or individuals could be transported, in reverse, to the parent college for the periods concerned.

Q : : *The speaker states that the reason for going to towns is one of home ownership. Car ownership is equally necessary in the country and it costs a man £3 a week to run an old car. Would not a loan of £1,000 to buy a late-model car be better, as it would cost less to run?*

A : : The aim of this paper is to suggest, first, a scheme whereby a farm worker is able to go to a country district, buy a section, build a home for himself and his family, and, if he desires, remain there in his retirement being amply provided for by a pension; and secondly, to suggest a scheme which will make it possible for any young farmer with no capital backing ultimately to own his own farm provided that he shows he is capable of measuring up to the standards required.

It is fully realized that a car plays an important part in keeping young men in the country. It may well be that, if the farming community generally is prepared to accept and support such basic ideas as are outlined, there would be no real difficulties in providing some form of scheme which would answer the questioner's problem.

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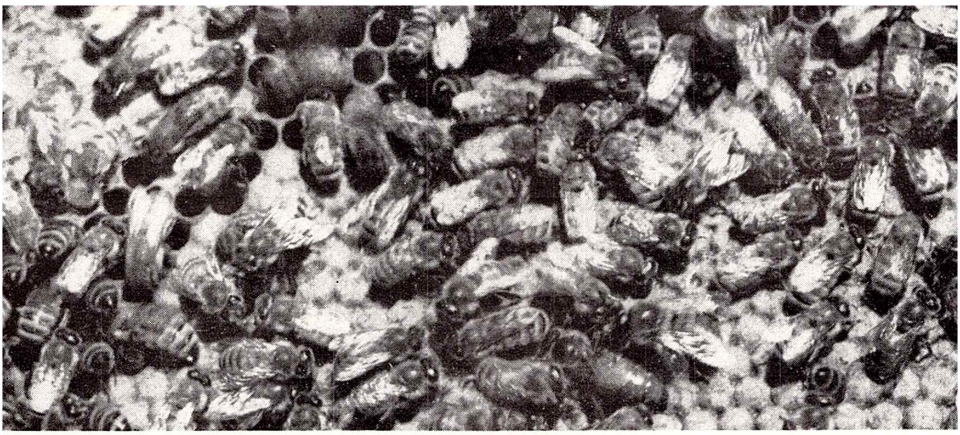
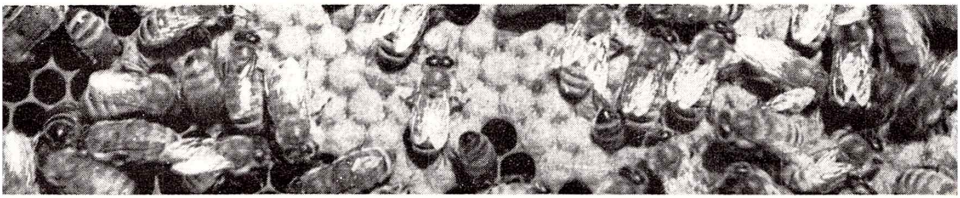


THE ROLE OF INSECTS AS POLLINATORS OF FORAGE CROPS IN NEW ZEALAND



Dept. of Agriculture photo.

L. GURR*

Pollination — the Process and How it is Achieved

POLLEN (the male spores) produced in the anthers (pollen sacs) must be transferred to the stigma (the tip of the female sexual organ) before fertilization (the union of the sex cells) can take place. Pollination is this transference. Some plants have their floral parts so arranged that self-pollination can take place simply by the action of gravity — the pollen grains when mature drop on to the stigma. Other plants, because the male and female sex cells mature at different times or occur on different plants, require some external agency to effect pollination. Pollen must be transferred from another plant. Wind or insects are the main agents by which this is achieved.

Insects visit flowers to gather nectar or pollen for food either for themselves or their brood. They may then effect pollination. To be efficient crop pollinators, however, they must occur in large numbers when the crop is in flower and visit many flowers per day. They must also work the

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flowers in such a manner that pollen adheres to their body and is carried to other flowers. Few insects fulfil all these requirements but bees do.

Bees are specially adapted for the collection of nectar and pollen. They have long tongues for the collection of nectar, and honey stomachs for its carriage. The body is covered with plumose hairs to which pollen grains adhere and the females have pollen baskets on the legs or abdomen for the carriage of pollen loads. They often occur in very large numbers. Those plants which rely on insects to effect pollination are themselves adapted, often in the most complicated manner, to attract the appropriate insect pollinator. Their flowers may be brightly coloured or scented to attract insects from a distance. Once on the flower, the insect is forced or guided by the shape or markings of the flower to brush against the anthers and stigma to obtain nectar or pollen. Cross-pollination may then be effected.

There are 20 species of bees native to New Zealand. None of these are colonial and consequently they seldom occur in sufficient numbers to be of much consequence as pollinators of crops. No other native insects have been shown to contribute significantly to the pollination of commercial crops in New Zealand. Insect pollination of fodder crops in New Zealand is therefore carried out almost entirely by honey-bees and bumble-bees. Both of these insects were introduced to New Zealand during last century for neither group is represented in the native fauna.

The chief fodder crops grown in New Zealand are grasses, legumes or crucifers. Wind is the principal pollinating agent of the grasses, and insects are the principal pollinating agents of legumes and crucifers; consequently this paper concerns itself only with the pollination of legumes and crucifers.

Pollination Requirements of Leguminous and Cruciferous Crops

Of the legumes that are grown in New Zealand for fodder crops, only subterranean clover, hop clover and serradella are self-pollinated. The lupins, black medic, and strawberry clover give better seed production if cross-pollinated by insects. All the rest, and these are the main ones, normally or entirely rely on insects for cross-pollination and will not set seed on a satisfactory basis without the assistance of bees.

CRUCIFERS

The crucifers have simple, open flowers. They are attractive to honey-bees and provide good supplies of both nectar and pollen. At the time when they normally flower, competing crops are not numerous and the attention that crucifers receive from honey-bees is high. Pollination of crucifers in New Zealand is thus satisfactory wherever sufficient honey-bees are found.

WHITE CLOVER

White clover is most attractive to honey-bees as a source of both nectar and pollen. It has a short corolla tube so that the nectar is always available to these short-tongued bees. The honey yield is high and the honey from this crop has high market value. Apiarists are, therefore, very willing to pasture their bees on it. Overseas the question of the number of colonies per acre (or bees per square yard) needed to set a maximum crop of white clover seed has not been settled. Some workers consider that one strong colony per acre or one honey-bee per square yard provides all the pollination the plant can use. It remains for local research to determine the requirements best suited for New Zealand. Bumble-bees also freely work this crop. It can be said that, for white clover, once the required number of bees is obtained, pollination is taken care of.

RED CLOVER

Red clover seed set in New Zealand is generally rather low and this is considered to be due to insufficient pollination. Honey-bees cannot always be relied upon to provide adequate pollination of this crop. The nectary of red clover is situated at the base of the long corolla tube. Often the nectar produced is not sufficient for it to rise high enough in the corolla tube for honey-bees to reach it with their relatively short tongue. Nectar gatherers, therefore, will not work a red clover crop that is not secreting heavily, or will suddenly leave it when the nectar flow falls off and the nectar becomes unavailable. Red clover is not rated as a high honey-producing crop (Bohart, 1960), and apiarists do not favour it as bee pasture. It competes well with other plants as a source of pollen for honey-bees. Pollen gatherers are effective pollinators. Pollen gathering honey-bees do not usually try to obtain nectar, and they visit flowers about twice as rapidly as do nectar collectors (Bohart, 1960). When honey-bees do work red clover they can be responsible for a considerable proportion of the pollination of this crop.

Bumble-bees, on the other hand, will work red clover with constancy and for preference. Their efficiency as pollinators of this crop was dramatically shown soon after their introduction to New Zealand last century.

Although honey-bees were introduced into New Zealand in 1839, no red clover seed was set here on a commercial scale until after the successful introduction of bumble-bees in 1885. By 1889 bumble-bees were well established and yields of 4 to 5 cwt of seed per acre were reported. This shows just how efficient the bumble-bee is as a pollinator of red clover under suitable conditions. Various overseas workers contend that bumble-bees pollinate between two and four times as many florets per minute as do pollen-collecting honey-bees (Bohart, 1957). From the writer's observations, it is known that bumble-bees will continue to work under much more adverse conditions than honey-bees and thus their total time in the crop is greater than that of honey-bees. When bumble-bees occur in sufficient numbers, they are the ideal pollinators of this crop.

LUCERNE

Lucerne varieties vary from completely self-sterile to slightly self-fertile. Pollination is dependent on tripping of the flower — an irreversible, explosive exposure of the sexual column of the flower. Under some climatic conditions, mainly low humidity and high temperature, automatic tripping can take place. This can result in self-pollination, and, in those varieties with some self-fertility, seed will set. Self-pollination, however, always results in smaller seed set. Cross-pollination is necessary for satisfactory commercial seed set.

Relatively heavy insects are necessary to trip the flower and both honey-bees and bumble-bees can do this. The configuration of the flower is such that, when the flower is tripped, the insect visitant is struck below the head by the tip of the flower's sexual column and pollen entangled in the hairs on the bee's head. Pollen from other flowers previously visited can be transferred at this time to the stigma and cross-pollination thus takes place. The explosive force of this process is distasteful to honey-bees and they soon learn to avoid it by alighting on the side of the flower and inserting their proboscis between the standard and wing petals, thus obtaining the nectar without tripping the flower. Pollination then is not accomplished. Most long-tongued bumble-bees collect nectar from lucerne this way, so they do not pollinate the flower either. The short-tongued

bumble-bee *Bombus terrestris*, however, invariably visits the flower in the normal manner and trips it, thus pollinating the flower (Gurr, 1955).

Lucerne is a good source of honey but it is not very attractive to honey-bees either for nectar or for pollen (Bohart, 1960). Many plants are more attractive to honey-bees and the question of competing crops in the vicinity of lucerne is of importance when considering their use as pollinators of this crop.

Widely varying results have been obtained with honey-bees as pollinators of lucerne in United States of America (Bohart, 1957). This is probably due to the difference from area to area, to cultural, climatic, and soil conditions varying the attractiveness of the plant to the insects. Nectar secretion and concentration depend on plant nutrition and climatic conditions. In dense crops the bees cannot reach the lower flowers. In open stands all flowers are accessible.

In New Zealand little is known of their efficacy as reliable pollinators of lucerne.

Bumble-bees, when they occur in sufficient numbers, are the best pollinators of this crop. The highest and most consistent seed sets coincide with the greatest concentrations of these insects in the South Island (Gurr, 1957a).

Pollination in General

In New Zealand, as in all temperate regions, the honey-bee is the most important insect pollinator and it undoubtedly contributes more to the pollination of commercial crops than all other species combined.

Farmers should be thankful that, because of the value of the honey and beeswax that the honey-bee produces, it is maintained at a high population level throughout most of the country. Thus, in consequence, the farmer receives the services of these pollinators free.

In the United States of America, the techniques of its use as a pollinator are receiving a great deal of study and seed yields have been increased by the purposeful use of honey-bees. Research has shown the numbers required for maximum seed set for a number of crops but the requirements vary greatly from area to area. Thus, only broad inferences for application in New Zealand can be taken from this work. More work will need to be done here before sound recommendations can be made for the use of honey-bees under local conditions. It should be remembered that honey production is at a maximum when a territory is stocked at a level much below that which is necessary for optimum pollination. The seed-grower consequently must expect to

compensate the beekeeper for loss of honey production if he expects him to concentrate on his crops the optimum number of bees for pollination. It is predicted that there will be a much wider, purposeful use of honey-bees as pollinators of red clover and lucerne when the techniques required for New Zealand's peculiar conditions are learnt.

The bumble-bee, on the other hand, is not so easily manipulated, but any effort to learn how to increase their numbers or efficiency as pollinators is well worth while, especially in the interests of red clover and lucerne production.

Four species of bumble-bees have been established in New Zealand (Gurr, 1957b). All nest underground in dry conditions in banks or rough ground.

Intensive cultivation reduces the available nest sites. Bumble-bees hibernate in winter but when they emerge in early spring, and throughout their active life in the summer, they require a continuous supply of nectar and pollen. Until the flowering of the legume crops, they rely mainly on a succession of weeds and wild plants for food for themselves and to raise a copious brood. The increasing use of weedicides has reduced this supply. It seems inevitable, then, that these trends in agriculture will result in an overall decrease in bumble-bee numbers unless they are purposely encouraged. Seed-growers, especially of red clover and lucerne, should purposely retain areas suitable for nest sites for bumble-bees. Bee forage plants, especially those that flower in early spring — *i.e.*, tree lucerne — should be grown to provide food in this time of natural dearth. Bumble-bee populations can thus be built up to useful proportions by the time they are required to pollinate the crops in late summer. Without the intervention of insects, pollination will not take place, and seed will not set. Bumble-bees are valuable. Farmers cannot expect to have their services when they are required and not support them for the rest of the year.

Each species of bumble-bee builds up to its maximum numbers at different times of the summer (Gurr, 1961). A knowledge of the life-cycle of the species that occur in a given district enables flowering time of the crop to be adjusted to coincide with the maximum numbers of pollinators. The decision as to the most appropriate time for shutting up a seed crop should depend on consideration of this factor. These are some of the ways that seed growers can make the best use of the natural pollinators — the bumble-bees.

It is hoped that this necessarily brief account of insect pollination gives some idea of the situation as regards this aspect of fodder crop seed production in New Zealand. Readers are, however, probably only too well aware of the fact that other factors influence the final seed yield. Varietal characteristics of the plant, cultural methods and crop management, soil and climatic factors, all contribute. Pollination, however, is a necessary prerequisite for any seed set and where insects are the chief agents of pollination they must be sufficiently abundant to accomplish it on a commercial scale.

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SUGGESTED FURTHER READING:

Two excellent general accounts of insect pollination of seed crops are the following:

Bohart, G. E., Todd, F. E. (1961): Pollination of Seed Crops by Insects in *Seeds: The Yearbook of Agriculture.* U.S. Dept. of Agriculture. pp. 240–6.

Todd, F. E. (1957): Insect Pollination of Legumes. Chapter 5 of *Grassland Seeds.* (ed. Wheeler, W. A., Hill, D. D.). Van Nostrand, Princeton. pp. 62–76.

DISCUSSION

Q : : *What role do bees play in hill country in relation to increasing clover seed set and thereby enhancing the soil fertility through increased numbers of clover plants?*

A : : None in the case of subterranean clover for it is self-pollinating, but bees are necessary for satisfactory seed set of white clover. White clover, however, is a perennial and does increase vegetatively; seed, therefore, is not the only means by which it increases. If increase by seed, self-sown, is desirable, then bees do have a very important role in ensuring this.

Q : : *Is the white butterfly important as a pollinator?*

A : : The white butterfly visits flowers only to obtain enough nectar for its own needs; therefore, the number of visits to flowers per day is few in comparison with those of bees. Bees collect both nectar and pollen for their brood as well as for their own use. The bee's method of feeding, with its very long mouthparts, enables it to obtain nectar from flowers with very little disturbance of the flower's reproductive structures. This reduces the chance of transference of pollen. Thus, although some pollination may be effected, it is slight. This is confirmed by L. Morrison (1961) (*N.Z. J. Agric. Res.*,

4: 560–565), who tested the efficiency of various insect pollinators. Caged plots of red clover to which white butterflies were introduced regularly throughout the flowering season, set practically no seed.

Q : : *Is the bee population affected by the increase in numbers of the German wasp?*

A : : Wasps do rob honey from honey-bee hives and can thus deprive the hive of its winter store of food. Wild bee populations could thus be reduced by these depredations. Domesticated bees are usually fed in the winter by the beekeeper and thus would not be affected. Wasps also catch other insects for food and may take and use bees in this manner. I would not, however, wish to guess how many bees meet such a fate.

Q : : *Is the phenomenon of the bumble bee puncturing the flower of the broad bean similar to the honey bee when it penetrates the side of the lucerne flower in search of nectar?*

A : : It is similar in the sense that in both cases nectar is obtained without tripping the flower. This irregular method of reaching the nectar does not result in pollination of lucerne but can do so in the case of broad beans. Broad beans are self-fertile and mainly self-pollinated (Soper, M. H. R. 1952: *J. Agric. Sci., 42*: 335–346). Movement of the bumble-bee on the outside of the corolla probably indirectly assists fertilization by disturbing the anthers and shaking pollen from them on to the stigma.

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SOME THOUGHTS ON SCOURING WOOL

T. A. MEEK*

THE NEW ZEALAND WOOL CLIP has reached the astounding total of 502 million lb in round figures, or 1,481,713 bales. (N.Z. Wool Commission Statistical Analysis 1960–61.) Of this total, approximately 12½ per cent. is scoured in this country before shipment to overseas destinations. The 1961–62 estimate is that 200,000 bales will be so treated and that 80 per cent. of this amount will be scoured to the order of buyers (*Wool Digest*, Vol. 13, No. 8). This leaves about 40,000 bales to be handled on behalf of growers by the 21 scouring works scattered throughout the country.

In the early days of the industry in this Dominion, it was the custom in many parts of the back country in the South Island, and on some of the larger stations in the North Island, to scour the clip on the station, or at the nearest scouring works. However, the increase of the clip, and the great improvement in transport faciilties, in turn gave rise to the expansion of the wool auction system and the practice of scouring at the source of supply has largely died out.

The woolscouring industry, as then constituted, was largely seasonal in its operations, and it was only in the period immediately prior to the second world war that some firms showed commendable vigour by modernizing their plants and offering to users facilities which were on a par with those of overseas operators. During the war, the scouring industry played a large part in handling a portion of the wool which had been bought by the United Kingdom Government, increasing their tally to about 20 per cent. of the clip by 1946. Since this time, the New Zealand Wool-

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scourers' Association has been alive to the possibilities of increasing business, and it works in close association with the New Zealand Wool Industries Research Institute (Inc.), Dunedin, where a full-time scouring research officer is employed.

In theory, the type of wool to scour is that wool which is going to be improved by scouring, and at this point the grower is obviously keen to know the answers to two questions:

(1) How does a grower know what type of wool to scour?
(2) What is the most significant aspect of wool improvement brought about by scouring?

The answer to the first question, "How does a grower know what type of wool to scour?" is to rely on his own experience — experience, of course, being that which enables a mistake to be recognized when it is made a second time! Failing personal experiences upon which he can place reliance, the grower should seek advice from other fields. It is in this sphere that the fields are wide open, and opinions, whilst certainly practical in their own way, are often varied. There is a neutral source, most competent in many ways, provided by the Department of Agriculture; then there are the interested parties, such as the local wool brokers, and scour executives, both of whom can give sound (though naturally enough slightly biased) practical advice.

The answer to the second question, "What is the most significant aspect of wool improvement brought about by scouring?" is that the right type of wool after scouring will enhance its "buyer appeal". To understand what really appeals to a buyer, the grower should extend his interest to beyond the sale room, and at least be appreciative of some of the fundamentals of wool processing. In order to deal with this "buyer appeal", it is intended to dwell a little on the manufacturing trade uses of New Zealand wools.

The wool manufacturing industry is broadly specialized to meet the requirements of (a) the worsted, and (b) the woollen sections, of the weaving trade. Although at one time these two branches of the industry used entirely different types of raw wool, the distinctions are not so marked today, and it is mainly as regards the methods by which the yarn is processed that the two branches are distinguished. The deciding factors as to which process a line of wool is best economically fitted for are not definite, and the same wool may be profitably absorbed by either branch of the trade. The long-held generalization that fleece wool should go to the worsted section and oddments go to the woollen section is no longer true; with fleece wool yes, but today oddments

are being absorbed more and more into the combing (worsted) section. It is, however, generally accepted that the long wools with degrees of soundness playing their part, in association with their length, go to the combers; while the shorter types are acquired by woollen operators.

Interest here will be confined to those wools which, because of reasonable tensile strength and their general suitability for combing are bought by, or on behalf of, topmakers. These wools are bought with the knowledge that they will be processed to the top, or combed, stage, and then offered for resale. Topmakers buy a wide range of wools which they blend to give a top with a reasonable repeatability. Business is on a speculative basis and the topmaker depends upon his skill and craftsmanship in the production of an article which he hopes will return him a small profit. It is this "blending with a reasonable repeatability", which should be the main concern when considering scouring on owners' account, and it is therefore necessary to try to appreciate the problems of the topmaker.

Tops are made in grades and qualities — the grades according to the types and style of wool from which the tops are made, and to the end use for which they are best suited; the qualities according to the sorting results of the wool from which these same tops had their origin. To achieve evenness in quality (fibre diameter) the topmaker resorts to sorting. Sorting is explained as "the dividing up of the contents of a bale or individual fleeces into groups according to their quality". Length and soundness play no small part in this operation, and yield, as expressed in terms of condition, is of little importance. Once wool has been scoured, however, sorting is described as being virtually impossible, and would present all sorts of difficulties even to highly trained personnel. All vestige of staple form has disappeared, and the perspective by which quality is commonly judged is lost.

The quality number of raw wool is decided by taking into account the number of staple crimps per inch, though other factors such as lustre, handle, fibre diameter, and, to a lesser degree in some cases, length, are all given consideration. The staple length of wool, which may determine the ultimate method of processing, would be more or less indeterminable as a result of scouring. One can only generalize when discussing topmaking standards, as lengths and qualities vary considerably between topmakers and between countries. However, these people are in general agreement that, in attempting to sort scoured types, low or inferior pieces of irregular quality may easily be missed, even by

experienced sorters, with consequent disastrous results in the final top. It can thus be clearly seen that, with most topmakers working to a price, a certain amount of blending of fleece and pieces may be indulged in. This has to be most carefully performed with regard to quantities, and can best be done by working wools in the grease.

The foregoing remarks would seem to rule out the possibility of selling scoured wool to topmakers' representatives. This, however, need not be so if certain preparation of the greasy wool is undertaken. It is the considered opinion of leaders in the trade that, unless the wools were sorted to Bradford standards in New Zealand before scouring, it will be a long time before encouragement in the buying of scoureds for bulk use in topmaking becomes a reality. A topmaker may take a chance by using scoureds only if they were very cheap, and, needless to say, such a blend would not be included as part of the best grade of top.

This would then surely rule out the recommendation to scour fleece types which under normal conditions would be accepted as topmaking wools. Nor can a blanket decision to scour pieces be given, since by the scouring of these wools all hope of their acceptance as combing types has gone.

Lest this grim picture completely destroy the morale of growers keen to make an honest penny, let us turn to the woollen section of the industry. Some authorities place the output of the wool textile industry as 50 per cent. worsted and 50 per cent. woollen, but New Zealand figures would appear to be more in the vicinity of a 70 per cent. to 30 per cent. ratio.

In the production of woollen yarn, manufacturers encourage the entanglement of fibres, and, to this end, employ blends of wools differing widely in length. There is, however, nothing haphazard about their method, and some of the best wool fabrics are produced by this branch of the trade.

Here, because of the blends which are used, scoureds can find a place. This is not to imply that "every free-for-all scientific mixture," will be acceptable to woollen operators. The question of raw wool types has to be weighed seriously, and thought and planning given to the putting together of a suitable blend. This is important, and from the farmer's point of view of economic returns it should be given more than passing consideration. The main operators on the buying bench, when a scoured catalogue is being offered, are merchants, or those who specialize in making and selling scoured blends. These people consider that they can pick up a quantity of wool in the scoured catalogue

well under the market price of similar types in the grease on that day, which of course obviates the necessity of their buying greasy wool and later having it scoured on commission. These merchants are quick to work out the scoured equivalent value of greasy wools, or vice versa, and will quickly snap up lots which are under their equivalent value. In terms of current market values, crossbred 46/50 average bulky pieces with an estimate of 64 per cent. yield, and selling at 33d. in the grease, should make at least 56¼d. scoured to be equivalent in value; reversing this, of course, should give the value of the pieces in the grease. It is this very point of view of the merchants, and their comparisons of wools similar in style, whether greasy or scoured, which arouses the ire of the woolscourers. The scourers maintain that, by their skill and scouring technique, they will raise the style of a line of wool from average to good, and that the merchants' comparison, following the usual line of comparisons, is rather odious.

Another point of interest here, which growers should note well, is the size and constitution of lots offered in a scoured catalogue. It is held as a matter of opinion that farmers' lots are usually limited in quantity and frequently do not represent a standard type. This, of course, is a matter of some importance to the merchant operator who prefers large lots. Through having little or no choice in the matter, he is forced to buy the smaller lots, which he then proceeds to blend away with other lots bought in the grease for scouring. The saleroom limit of these scoured wools is therefore discounted by at least a penny to cover the blending charge; on occasions, the discount may be to the tune of threepence where re-scouring is deemed necessary, though this latter course is not usual.

At an earlier stage the question was asked, "Why is wool scoured?" The query which should now be put is, "Why do *you* scour wool?" The answer to this could, of course, be contained in the following: (a) To save freight charges by removing the washable non-wool constituents; or (b) in the belief that the returns from the sale of scoured wool are greater than those which that wool would realize if sold in the grease; or (c) to avoid the responsibility, and necessity, of some form of preparation of wool for market.

The scoured catalogue now offered at Napier is an established fact and the growth from 479 bales offered at auction in all New Zealand sales in the 1951–52 season, to a total of approximately 17,000 at Napier alone in 1961–62, shows that there is something attractive in this method of disposal of wool.

Without a doubt the quotations for scoured types, by comparison with the returns from greasy wool, do appear to be most lucrative; but in the wordst of the old proverb "all is not gold that glisters". By way of example, a return of 58d. per lb for a parcel of fleece scoured at 75 per cent., would give no greater return than that original weight of fleece, shown in the grease, and realizing 40½d. This question of relating the price of the scoured product back to equivalent value in the grease should not be overlooked, though, unfortunately, it is only after the auctioneer's hammer has fallen, and values worked back, that it can be seen whether or not the scouring of wool has been a profitable venture.

It is claimed by many that the removal of sand and dirt and other washable non-wool constituents is economical, and saves freight, but growers should realize that there is 0.9d. difference in the freight rates when shipping greasy and scoured wools.

For easy computation these rates are approximately 3¼d. for greasy wool and 4¼d. for scoured wool*. When coupled with the average bale weights of 336 lb greasy, and 280 lb for scoured wool, it will be seen that there is little enough difference between these wools without taking the 3d. scouring charge into consideration.

It will thus be seen that the question of scouring on owner's account is most complex and that wool processors, whether worsted or woollen, prefer to run their own businesses and to put down their blends accordingly. Manufacturers, however, must acquire wool stock from somewhere and growers fill this need either by offering their clips in the greasy or scoured state. There is always some element of risk when wool is offered for sale, and this risk is often magnified in the mind of the grower, because of the necessary (for price estimation) application of a yield estimation. As a body, buyers will be the first to admit that they tend to underyield high-yielding wools, and overyield low-yielding wools. If this is so, then it is obvious that farmers should therefore find it profitable to scour second-shear and other likely high-yielding wools, and leave the low-yielding wools to the other fellow. After all, the buyer who miscalculates does have an avenue of escape, in that he combines many lots to make up a large order, and consequently has the opportunity to balance overyields with underyields.

* The shipping rates are: Greasy 2.9938d. + 10% primage; scoured 3.8038d. + 10% primage.

To quote a case in point where second-shear wool was scoured with advantage to the grower: The clip concerned wool shorn from ewes, which had been dipped only a few weeks previously. Consequently, the product was poor in colour, being what could best be described as dull grey, and it also exuded the unmistakable aroma of recently dipped wool. A portion of the clip was binned and the rest sent to the scour. The binned parcel was sold for 40¾d. The scoured line, with the smell gone and the colour now most attractive, realized 56d.

The scouring yield was 88 per cent., and by taking 88 per cent. of 56d. and deducting 3d. as cost of scouring, then the greasy equivalent price of the scoured wool was 46¼d. This shows a useful net premium of 5¾d. per lb when compared with the actual price of the greasy wool of 40¾d.

By way of comparison, another recent catalogue included a lot of second pieces and lox which was passed, in the saleroom, at 19½d. If the line in question had been quit at this price then the net return to the grower would have been £165 9s. 4d. This particular wool, however, was scoured, and later sold with a net return of £165 0s. 3d. This showed that scouring in this case was not justified.

These heavy-conditioned, poorly coloured wools are frequently hard to improve by scouring, and the job, no matter how well done, may uncover other coloured faults as well as fibre damage, which will leave the wool with an average or inferior grading. One of the best examples in such a case concerns, of course, muddy wools. These can present problems in scouring, and if the wool, and the mud, are wet, at the time of shearing, the grower has little option but to scour. In such a case this wool should not be pressed, but fadged up and transported to the scouring works as quickly as possible. Wet pressed wool will deteriorate both in colour and fibre substance very quickly and in extreme cases the damage will leave the fibre as a brown mass with all vestige of fibre strength and soundness gone. The cost of scouring is based upon the inward weight of greasy wool, and muddy wools present problems to scourers. In the case of muddy and wet wool, the scourer frequently makes some concession in the interest of good fellowship and good business.

A strong case can usually be put up in favour of scouring some wools which are artificially coloured. Buyers, in general, are "colour shy" and apprehensive about the complete removal of such stains during scouring operations.

The increased use of tupping paste and crayons is noteworthy in this respect. The price of such coloured wools would be heavily discounted in the grease, but these colours could be removed by scouring. Remember, too, that buyers have in the past been caught by the presence of brands in greasy wool. Branding materials as marketed are expected to scour out under normal scouring conditions, but when adulterated by engine oil or roof paint will defy even the most concentrated of scour liquors.

To sum up then, scour if you have to, or if you deem the time to be ripe for a sporting venture. If in doubt, seek sound advice, and have no recriminations if the results do not pan out quite as intended. As one of my Yorkshire friends says "the most stable thing about the wool market is its glorious uncertainty".

Remember, too, the buyer is not always the one to blame; he may be buying on commission, and, such being the case, would welcome the opportunity to advance his bid many times on your lot, but his limits are controlled by the manufacturing end of the business, where everything has been costed down to the last farthing.

DISCUSSION

Q : : *Do buyers purchase scoured wool with more confidence than they do greasy wool?*

A : : It can perhaps be said that buyers purchase greasy wools almost "expecting" to find odd bits and pieces by way of offsorts; in scoureds, however, these faults have virtually disappeared either by sorting or as a result of the scouring process. Furthermore, the hazard of a faulty yield assessment has been removed when scoureds are being considered.

Q : : *Is there an economic future in New Zealand for the making of top wools for export?*

A : : We certainly have our own wool, but the fact that topmakers blend other wools with New Zealand wools must not be lost sight of. Wages are presumably higher here than overseas, which of course would add to the cost, and, in addition, we would have to establish a market for our product. Topmaking is a craft and it has been developed to the last degree overseas. When wool is landed in a country at a clean price of 66d., a combing charge of 9d. per lb is paid, and the ensuing top sold for 75d., the noils at 43d., and a dividend paid at the end of the financial year. You will understand, therefore, what is meant by "a craft".

Q : : *Is there a consistent and significant advantage in scouring second shear wool?*

A : : This is rather difficult to establish. All wool is bought against a clean price and, in the case of high yielding second shear wool, the grower will no doubt benefit through scouring. On the other hand, the second shear wool market today is governed so much by length that it is probably better left for the buyer to scour. The fact that the parcel of wool may not fit a standard type and that the quantity may be small, must also be considered.

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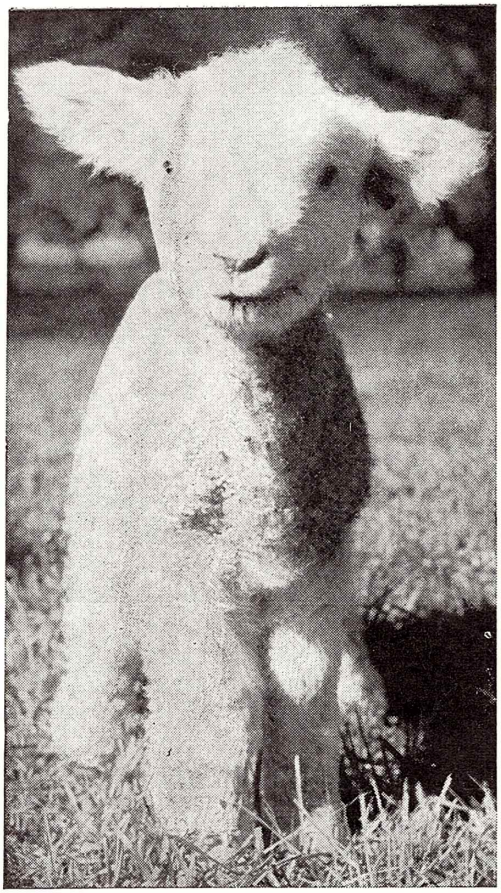

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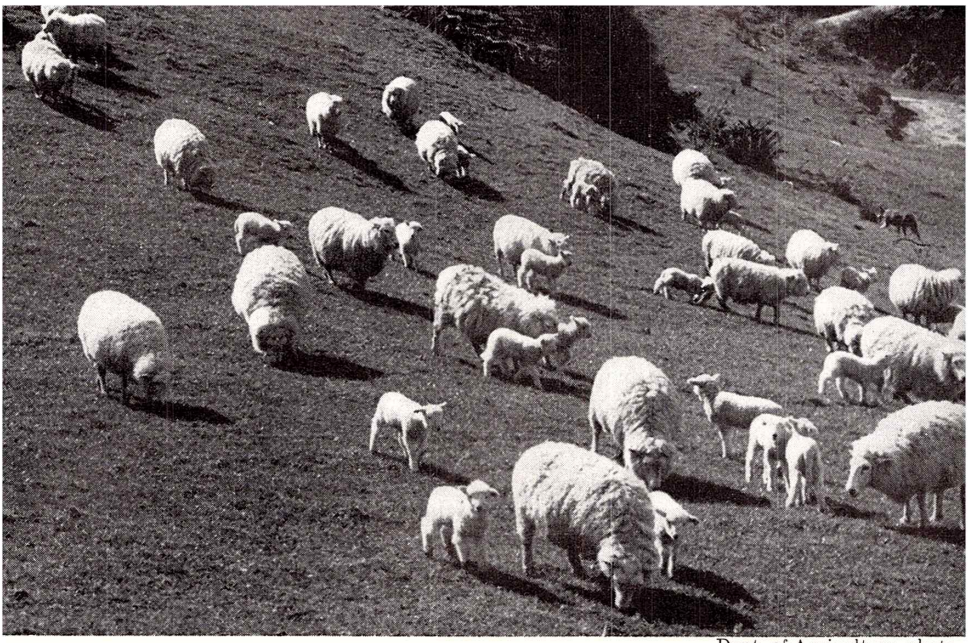

Dept. of Agriculture photo.

Border Leicester × Romney crossbreds at the Whatawhata Hill Country Research Station.

CROSSBREEDING IN SHEEP

E. A. CLARKE*

CROSSBREEDING to increase animal production is a technique as old as animal husbandry itself. It is doubtful whether there is any important improved breed in use today which has not originated from crossbreeding in fairly recent times. The original English Leicester sheep, selected by Bakewell but of little importance today, was used in the evolution of many British longwool breeds, such as the Lincoln, Cotswold, Wensleydale, South Devon, Devon Longwool and Border Leicester. The Southdown was used to improve many British Down breeds widely used today. In more recent times, well-known breeds such as the Corriedale, New Zealand Half-bred and Polworth, have been evolved by crossbreeding. It is safe to say that the New Zealand Romney of today owes something of its superiority over the original Kent sheep to the Merino, Lincoln, English Leicester and Border Leicester which were used in forming the Romney crossbreds of New Zealand before the closing of the Romney flock book.

In all parts of the world, innumerable new breeds of livestock better adapted to their environment have been recently evolved by crossbreeding. It is probably equally

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true that many crossbreds have failed to achieve a place in the livestock world; the successes tend to be recorded and the failures forgotten. Within a breed there is generally believed to be a genetic limit or ceiling to improvement and the more nearly this ceiling is approached by breeding and selection the slower is the progress made. At this stage crossbreeding may prove a short-cut to further progress.

For most characters, the crossbred is intermediate between the two parental breeds. Information available from the many crossbreeding trials which have been carried out support this contention, as do the results from recent trials in New Zealand. The marked exceptions to this general rule are in respect to the fertility of the first-cross ewes and their milk production, measured either directly or indirectly through the growth rate of the lambs. In most crossbreeding trials where these characters have been measured, they have been found in first-cross ewes to be greatly above the mean of the parental breeds. It is these characteristics of the first-cross ewes that are so striking and spectacular and which are often taken full advantage of in fat-lamb farming as, for example, the use of the Border Leicester × Cheviot ewes in Great Britain.

A common objection to crossbreeding is the belief that although the first-cross animals may be quite uniform, if these are bred from, the resulting progeny show marked variation. In crossbreeding trials at Massey College with Cheviots and Romneys, and at the Whatawhata Hill Station with Border Leicesters and Romneys, increased variation in the progeny of first-cross ewes has not occurred in the important commercial qualities such as body weight, birth weight, and fleece weight. Work in other countries supports these findings.

The characteristics of commercial importance are complex in their inheritance, dependent upon many genes and gene combinations, and are greatly affected by environment. The observed variation is so largely due to environmental influences that any increase in hereditary variability — and there is undoubtedly some increase — is such a small fraction of the total variability that it is not observed.

It should be borne in mind that if, for example, one selected 100 even purebred ewes from a flock of 1,000 their progeny would show variability, comparable not with that of their 1,000 parents but with that of the 1,000 ewes from which the parents were selected. Likewise, in crossbreeding, the progeny of crossbreds should be contrasted with regard to variability, not with the few selected parental types used, but with the greater population from which the parental generations were selected.

Much of the misconception regarding the variability of crossbred sheep stems from a belief that all inheritance follows the classical Mendelian pattern where, for example, roan cattle, resulting from crossing red and white Shorthorns, when bred from give reds, roans and whites. In this type of simple inheritance, where environmental influences do not much affect the character, variability is reduced in the first cross but is increased to cover the entire range found in the parental generation when the first cross is bred from. As has already been pointed out this type of simple inheritance does not apply to the important production characteristics of sheep.

Crossbreeding Trials

One of the first problems obviously demanding attention when the Whatawhata Hill Station was first established was that of low lambing percentage in hill country flocks. A first approach to the problem was to see if ewes of known high fertility could maintain their high fertility in the hill environment. With this object in view, Border Leicester rams of the best type available, and preferably twins, were purchased and crossed with good quality Romney ewes purchased from an old-established hill country flock, with a good lambing percentage by North Island hill country standards.

The results obtained in these early trials with Border Leicester × Romney halfbreds clearly demonstrated that these sheep could show a very high level of fertility in spite of the difficult environment. This was the main object of these trials.

The level of production of the halfbreds was so high, however, that it was considered desirable to carry out further trials. The object of this paper is to give a brief and unbiased account of the results obtained. It is hoped that others who have tried this cross will, in the discussion, give the benefit of their experience and so contribute to a better understanding of the advantages and disadvantages of crossing Border Leicesters and Romneys.

In all trials to be reported, a flock of Romney sheep of the same approximate size and age composition has been run with the crossbred sheep at all times except during mating. These Romney sheep are the same in all respects as those used to breed the crossbred ewes and are referred to in the tables and discussion as Romney Control sheep.

CROSSBREEDING FOR FAT-LAMB PRODUCTION

In New Zealand, farmers are familiar with a fat-lamb farming system where hill country ewes are brought to the lowland country and mated to Down rams which give early

maturity and rapid growth rate to the lambs. In other countries, greater stratification of the fat-lamb industry is seen. Ewes from the breeding flocks, usually from hill country, are mated, in a new and easier environment, with rams of another breed to produce halfbreds. The aim is to produce a ewe of enhanced fertility and milk production. These halfbred ewes in the true fat-lamb environment are then mated to Down breeds to produce very rapid growing and quick maturing fat lambs. This system is commonly used in Australia where Merino ewes are mated with Border Leicester or Dorset Horn rams and the halfbred ewes are then mated with Down rams.

In the Whatawhata trials, halfbred ewes bred on the hills were transferred to easier country on the Station at 5 years of age and mated to Southdown rams. Romney ewes of the same age from the Control flock were run and mated with the halfbreds. A summary of four years' results for 5-year ewes and three-year results for 6-year ewes is given in Table 1.

TABLE 1: Production from Halfbred and Romney Ewes — Fat Lamb Flock

	Halfbred		*Romney*	
	5-year	*6-year*	*5-year*	*6-year*
Lambing %	136	125	102	98
Fleece weight (lb)	7.4	7.2	7.5	7.0
Birth weight (singles) (lb)	10.6	10.6	10.2	10.1
Weight of lamb reared per ewe mated (live wt.) (as at 1st draft) (lb)	70	68	50	47
% Lambs picked on 1st draft	47	59	42	34
% Prime and Down 1st draft	84	97	71	79

The increased level of fertility in the halfbred is clearly seen, as is the better milking and mothering ability expressed in the growth and grading results for the lambs. An increase of 40 per cent. in the weight of lamb weaned per ewe mated summarizes the gain in production due to these factors and the heavier birth weight of the lambs.

Fleece weight has also been maintained, as has the value per pound, the wool from the halfbred being only slightly stronger than that of the Romney. (It should be pointed out that the fleece weights are for the shorn fleece only and do not represent total wool production, which would be about 1½ lb higher.)

The level of production in these trials is not great but the results have been achieved on country which can be regarded as only marginal for fat-lamb production. At Lincoln College, under good fat-lamb farming conditions,

this greatly enhanced production of the halfbred has been of a similar or greater order but at higher levels.

The greater maintenance requirement of the somewhat larger halfbred must be offset against the increased production. A preliminary estimate of this at Whatawhata is about 17 to 18 per cent., so that carrying capacity might be reduced by something of this order as would wool production per acre. This would greatly reduce the superiority of the halfbred. What is not known, however, is the actual relative carrying capacities of the two breeds. This would take into account not only appetite but foraging ability and efficiency of conversion of pasture into animal products. It is doubtful, however, whether in the final analysis, taking into account current values of meat and wool, the superiority of the halfbred is as great as it would seem at first sight.

CROSSBREEDING OF HILL COUNTRY SHEEP

Unlike the fat-lamb flock which is maintained by purchase of ewes, the hill country flock is generally maintained by breeding. If crossbreeding is embarked upon, the question immediately arises as to the way the first cross ewes are to be mated.

There are several possibilities but trials have been confined to investigating two of these.

1. Back-crossing to the Romney Ram

This is illustrated schematically in Fig. 1. The rapid decline in fertility, expressed as lambing percentage, is clearly shown in Table 2. This trial has been abandoned since it was obvious, because the decline in fertility was so rapid, that even with the most intensive selection possible any marked improvement of Romney fertility could not be achieved in this way. Back-crossing to the Border Leicester ram was not considered since this breed is so ill-adapted to the hill environment.

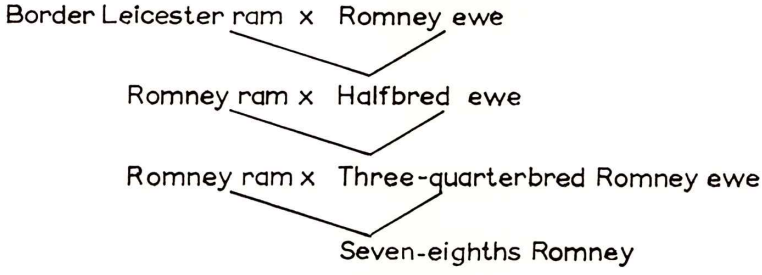

Border Leicester ram x Romney ewe
Romney ram x Halfbred ewe
Romney ram x Three-quarterbred Romney ewe
Seven-eighths Romney
and so on

Fig. 1: *Back-crossing to Romney.*

TABLE 2: Back Crossing to Romney
Lambing Percentages (2 yr av.) (Lambs Docked per 100 Ewes Mated)

Halfbred				*¾ Romney*				*⅞ Romney*		*Romney*			
2-th	*4-th*	*6-th*	*4-yr*	*2-th*	*4-th*	*6-th*	*4-yr*	*2-th*	*4-th*	*2-th*	*4-th*	*6-th*	*4-yr*
95	110	120	120	84	88	100	108	73	58	57	89	99	98
	104%				82%				69%		72%		
		112%				90%						82%	

2. *Breeding the First Cross and Subsequent Generations to Halfbred Rams*

There are two main ways of doing this.

(a) *Interbreeding the first cross*:

This is the method used traditionally to form a new breed. Once the first cross has reached sufficient numbers, the original breeds are no longer needed and rams are selected within the closed flock.

(b) *Using first-cross rams in each generation*:

This is the method used at Whatawhata to maintain the halfbred type. It is the method used to breed the New Zealand Halfbred (Longwool-Merino cross). It has the advantage that any improvements brought about in the parental breeds can be introduced into the halfbred through the ram. At any time this method can be easily changed to method (a) and the formation of a new self-maintaining breed. The two methods are illustrated schematically in Fig. 2.

In trials the data obtained so far are only for first-cross ewes and their progeny as two-tooth and four-tooth ewes. The mean lambing percentages are shown in Table 3. The superiority of the halfbred (F_1) over the Romney is seen at

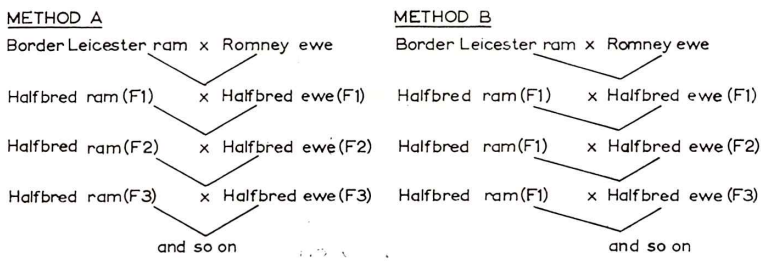

METHOD A
Border Leicester ram x Romney ewe
Halfbred ram (F1) x Halfbred ewe (F1)
Halfbred ram (F2) x Halfbred ewe (F2)
Halfbred ram (F3) x Halfbred ewe (F3)
and so on
METHOD B
Border Leicester ram x Romney ewe
Halfbred ram (F1) x Halfbred ewe (F1)
Halfbred ram (F1) x Halfbred ewe (F2)
Halfbred ram (F1) x Halfbred ewe (F3)
and so on

Fig. 2: Two systems of breeding halfbred sheep.

all ages but particularly in the two-tooth ewes. The interbred halfbreds (F_2) show a marked decline and are on average only 7 per cent. better than the Romneys. Although the numbers are small in the F_2 generation, the picture has been consistent in each of the two years for the two-tooth ewes.

TABLE 3: Crossbreeding Flocks

Five-year Average Border Leicester × Romney = Halfbred (F_1)				*Five-year Average* Romney Control				*Two-year Average* Halfbred × Halfbred = Halfbred (F_2)	
2-th	*4-th*	*6-th*	*4-yr*	*2-th*	*4-th*	*6-th*	*4-yr*	*2-th*	*4-th*
83	108	116	114	54	87	97	95	70	90
95%				69%				76%	
105%				81%					

The level of fertility in the Romney two-tooth ewes is low. These are run at all times except during mating with the comparable crossbreds and all are run under the hardest of hill country conditions on the Station. This, combined with facial eczema precautions, which affect the smaller Romney two-tooths more severely, contributes towards a low lambing percentage. The liveweights of the two-tooth ewes at mating time for the two past seasons are illustrated in Table 4.

TABLE 4: Liveweight (lb) at Mating and Lambing Percentage of Two-tooth Ewes

	1960		*1961*	
Flock	*Live Wt. (lb)*	*Lambing %*	*Live Wt. (lb)*	*Lambing %*
Halfbred (F_1)	88	73	97	92
Halfbred (F_2)	86	66	93	76
Romney Control	75	40	85	57

It has been shown by Wallace in trials at Ruakura and in trials at Whatawhata Station, that liveweight at mating and subsequent lambing percentage are strongly correlated. In Table 4 the effect on lambing percentage of comparatively small differences in liveweight are clearly demonstrated both within and between flocks. In the year 1960, the ewes were shut up five times as a precaution against facial eczema.

The greatest single factor contributing to low fertility in hill country two-tooth ewes is their lack of size. In trials with Romneys, more efficient hogget rearing, combined with more intensive mating and pre-mating shearing, have

enabled lambing percentages approaching 80 per cent. to be achieved under hill country conditions. With halfbred ewes similar techniques have resulted in lambing percentages of about 100.

Differences in size between Romneys and halfbreds commence at birth when the first cross halfbreds are about ½ lb heavier than Romneys, and the F_2 halfbreds are intermediate in size. This difference increases to about 5 lb by weaning time and gradually increases thereafter so that by mating time the two-tooth ewes have diverged in liveweight as shown in Table 4.

In May of this year the mean liveweights of the hoggets were in descending order from the F_1 halfbred to the Romney as shown in Table 5 and suggest a decline in vigour in successive generations from the first cross (F_1).

TABLE 5: Liveweights of Ewe Hoggets — May 1962

	Halfbred			
	F_1	F_2	F_3	*Romney*
Liveweight (lb)	64	59	56	53

Table 6 illustrates some of the main factors which contribute to the final lambing percentages (lambs alive at 28 days as a percentage of ewes mated) for the 1961 season. The data for this season are the most complete, to enable a comparison between the Romney and the F_1 and F_2 halfbreds.

TABLE 6: Crossbreeding Flock 1961

	2-th	*4-th*	*6-th*	*4-yr*	*Total*
Ewes lambing as % of ewes mated:					
Halfbred (F_1)	97	95	100	93	95
Halfbred (F_2)	84	85			
Romney	69	81	85	88	82
Ewes with twins as % of ewes lambing:					
Halfbred (F_1)	11	18	38	34	22
Halfbred (F_2)	7	12			
Romney	4	12	17	17	14
Lambs born alive or dead as % of ewes mated:					
Halfbred (F_1)	108	112	138	125	117
Halfbred (F_2)	89	96			
Romney	71	91	100	103	93
Lambs alive 28 days as % of ewes mated:					
Halfbred (F_1)	92	110	138	114	108
Halfbred (F_2)	76	90			
Romney	57	88	97	102	88

The higher lambing percentage of the halfbred over the Romney is clearly due to a big reduction in the number of dry ewes in all age groups and to a marked increase in twinning, especially in the older ewes. There tends to be on average a slightly higher death rate in the lambs from the halfbreds which is to be expected because of the higher incidence of twins. The F_2 halfbred tends to be intermediate between the F_1 halfbred and the Romney for the characteristics listed.

Mean fleece weights are shown in Table 7 where it will be seen that the halfbred (F_1) averages about 0.3 lb more wool than the Romney. There are as yet insufficient data on the wool production of the F_2 halfbred. There is little difference in fleece quality between the halfbred and the Romney — the wool of the former is slightly stronger but value per pound is similar.

TABLE 7: Fleece Weights of Crossbred Romney Ewes (Shorn Fleece Only)

Romney	(5yr av.)	.....	.....	8.8*	8.0	7.9	7.8	8.1
Halfbred (F_1)	(5yr av.)	.....	.....	9.1*	8.4	8.4	7.9	8.4
Romney	(2yr av.)	.....	.....	7.8	7.7	7.7	7.8	7.7
Halfbred (F_1)	(2yr av.)	.....	.....	8.1	7.9	8.3	8.1	8.1
Halfbred (F_2)	(2yr av.)	.....	.....	7.7				

* Includes three seasons of 14-months' growth.

Again in these flocks the maintenance requirements of the heavier halfbreds is probably greater than that of the Romneys by about 17 to 18 per cent., which greatly reduces the superiority of the halfbred production. In spite of heavier fleece weights, the wool production per acre of the halfbreds might be expected to be below that of the Romneys. Any marked differential in favour of the Romney in the market value of surplus two-tooth ewes and cast-for-age ewes could offset much of the extra production of the first-cross sheep.

Should the fall in per ewe production be marked between the F_1 and subsequent generations the substitution of halfbred flocks for Romney flocks on hill country might have little merit.

The farming of a smaller flock of halfbred sheep to achieve the same production or return as a greater number of Romneys might have considerable merit. The easier shepherding of the halfbred also has some value.

These prognostications may be taken as a condemnation of the use of halfbred flocks. This is not intended. The writer wishes only to sound a note of caution at this stage as more information is needed. The relative carrying capacities of

the two breeds under farming conditions need to be determined. The estimates are based solely on the relative liveweights of the two breeds and take no account of possible differences in efficiency of grazing and pasture conversion. What is of paramount importance also is the level of production that can be achieved in the interbred halfbreds, and in this regard data are as yet meagre but they do suggest a need for caution.

Summary

(1) Trials carried out with Border Leicester × Romney halfbred sheep, on hill country and under fat-lamb conditions, clearly demonstrate marked increases in per animal production over that of Romney sheep run under the same conditions.
(2) Results show that variability in the first-cross ewes and in their progeny has not been demonstrably increased.
(3) Preliminary estimates of the relative carrying capacities with the two breeds suggest that much of the increased per animal production achieved with halfbred sheep may be much less spectacular on a per acre basis. Further work must be done to evaluate the production of the two breeds on this basis.
(4) The level of production of the interbred halfbreds has not yet been adequately determined but results to date suggest that it may be appreciably lower than that of first-cross sheep.

Acknowledgements

I should like to express appreciation of the careful work done in the collection of data, by G. Reid, Technician in charge of the Breeding Flocks and P. Muller, Technician in charge of the Fat Lamb Flocks and by Miss P. Tennant who has been responsible for the compilation of the data.

DISCUSSION

Q : : *Are the teeth good in the sheep at Whatawhata?*
A : : On Whatawhata the wearing qualities of teeth are excellent. Nine-year-old Romneys still have sound mouths. No differences between halfbreds and Romneys have been noticed.

Q : : *For how long are dry ewes retained in the experimental flocks?*
A : : Ewes are culled if dry for two consecutive lambings. About three per cent. of ewes come into this category and 60 per cent. of these lamb after intensive mating. The remainder are permanently infertile due to a number of causes, the most important of which are occluded Fallopian tubes and undeveloped reproductive tracts. Permanently infertile ewes are no more than about one per cent. of all ewes.

Q : : *Would the selection of Border Leicester rams account for the fall-off in vigour of the F_2 and F_3 generations?*
A : : The same Border Leicester rams were used to breed the first cross rams and the halfbred rams to breed the subsequent generations of halfbreds.

Q : : *Where the flocks are carried, is topdressing with superphosphate done annually?*
A : : Yes, two hundredweight per acre per annum. Carrying capacity has increased fourfold. The Romneys and the halfbreds still show the same differences in production today as they did in the past.

Q : : *Is there any difference in the incidence of footrot between the two breeds of sheep?*
A : : Footrot is not a problem on this country and no difference between the halfbred and Romney has been observed.

Q : : *Have trials been carried out into the breeding of ewe hoggets of both Romney and halfbred breeding?*
A : : Well-grown halfbred hoggets have given up to 80 per cent. lambing. Limited trials with Romneys have given figures of about 40 per cent. under these conditions.

Q : : *Would the production figures be higher if the Cheviot or Perendale was used instead of the Border Leicester ram?*
A : : We have not made these comparisons.

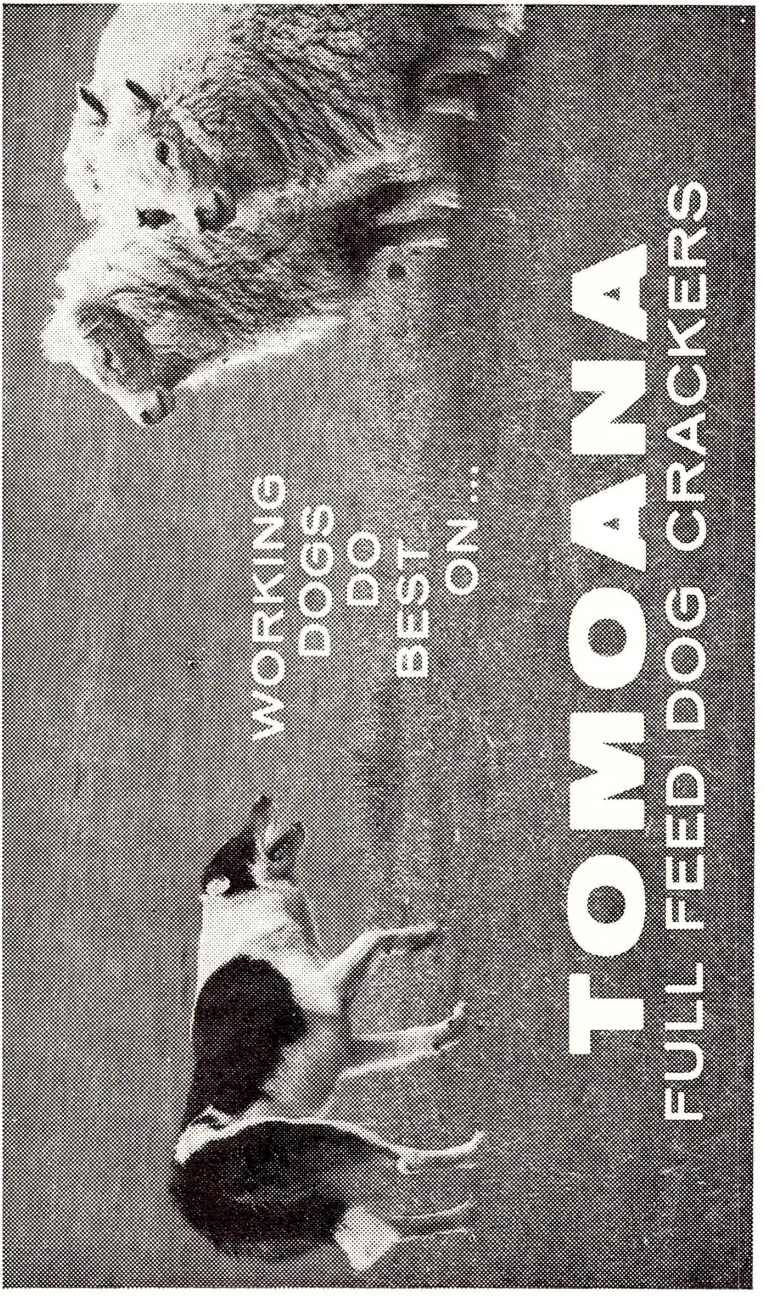
Q : : *Why are the teeth of the sheep so good when the soil at Whatawhata is possibly low in calcium?*
A : : There is no calcium deficiency in this country. The soil pH remains at about 5.6.

Q : : *Has there been any change in wool fineness between second (F_2) and third (F_3) generations of halfbreds?*
A : : The mean wool count in the halfbred tends to be intermediate between the means of the parental breeds. No difference in fineness has been observed between the F_1 and F_2.

Q : : *Have all the Border Leicester rams come from the same stud flock? Have you tried a strain of Border Leicesters which has high fertility but is of small body size?*
A : : The first rams were imported from Australia. Subsequently, rams have been purchased in New Zealand mainly from one stud where they are selected as twins and for wool type. I am not aware of any marked strain differences between Border Leicester studs in New Zealand.

Q : : *Is it more economical to carry more inferior small sheep rather than fewer superior large sheep?*
A : : This depends to some extent on the relative values of wool and meat. The greater wool production of a larger number of smaller sheep may result in better returns per acre. Other considerations, such as foraging ability, etc., can only be guessed at until trials have been carried out to test these specific points.

Q : : *Can Mr Clarke comment on criss-cross breeding where some animals are always mated to the parent breeds; that is, halfbreds, some of which are mated to Romney rams and others to the Border Leicester?*
A : : This criss-cross pattern of breeding has been quite widely used in crossbreeding and maintains the halfbred type fairly satisfactorily. In the hands of the farmer, unless recording and identification are carefully carried out, it could lead to much confusion.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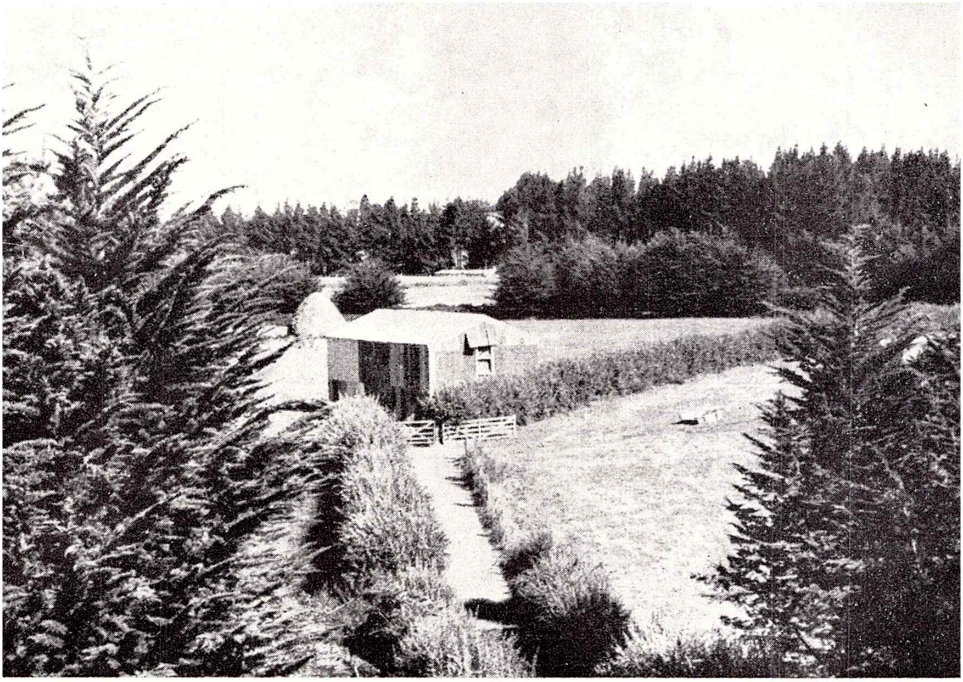

FARM FORESTRY

N. A. BARR*

IN THE PAST, in any discussion on land use in the North Island, the two main considerations were dairy and sheep farming, or a combination of them both, but, with the cutting out of native timber stands and the building up of an export market for timber and pulp products, increasing thought is being given to the use of land for tree growing. It is unfortunate that at times the question of farming, or trees, is debated with some vigour by the two large Government departments involved — Lands and Survey and N.Z. Forest Service. As a result of their "negotiations" a policy of farming *or* trees seems to have come about, and has resulted in much valuable farming land being tied up for forestry and, in the large-scale land projects, many areas suitable only for tree growing, being grassed down, eventually to erode or return to gorse. Where the district is situated in a timber-hungry area, or is one where timber or pulp is needed for export, there are good reasons why farming *and* trees could form a very happy combination. The use of trees can bring benefits to land already in grass, too, by providing shelter and useful farm timbers.

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Trees bring income to the farm:

(1) By providing shelter for grass and crops against cold temperature-lowering winds and evaporation by the hot drying winds of summer.
(2) By giving protection to lambing flocks against those severe, unpredictable storms of the spring.
(3) By providing shade for stock and homestead.
(4) By supplying fencing material and farm timbers at low cost.
(5) By providing a very valuable cash reserve in the form of a mature, well-tended woodlot that can be realized in times of recessions or when death duties are needed.

Shelter and Shade

VALUE

It is very hard to obtain an accurate assessment of the value of shelter on those farms of flat to rolling contour where shelter is needed so badly. No research has been done in this field in New Zealand but it is reasonable to assume that there must be improvement in grass production and its utilization behind well-designed and planned shelter-belts. Wind is New Zealand's worst climatic enemy. A cold driving wind can lower the ground surface temperature by some degrees in times when grass is urgently needed. It is well known that a drop in temperature means a drop in pasture or crop growth rate when the ground has sufficient moisture. Further, grass on the windward side of a spur grows less vigorously and dries out earlier than that to leeward. It is common to hear of lucerne crops in Canterbury giving one or more cuts extra in sheltered fields, and of hay crops being heavier.

Near the Whenuapai Airport some shelter — about 50 per cent. adequate — was felled to make way for a runway. Production on this farm dropped sharply by 11 per cent. in spite of a 5¼ per cent. increase in the herd averages in that herd-testing area — a loss of 16¼ per cent. On this basis, with shelter 100 per cent. adequate, it is possible that production figures may have been over 30 per cent. higher.

At the Forestry School in Canberra, which is built on an exposed, cold plain (which can also be hot), measurements taken between 1930 and 1955 showed a drop in wind mileage from 43,000 units to 27,000 units, as a result of the ornamental plantings around the new city.

Losses at lambing time can be high in exposed paddocks, up to 20 per cent., and this is more expressly so on the easy, rolling land — easy of access, easy for wind to blow across.

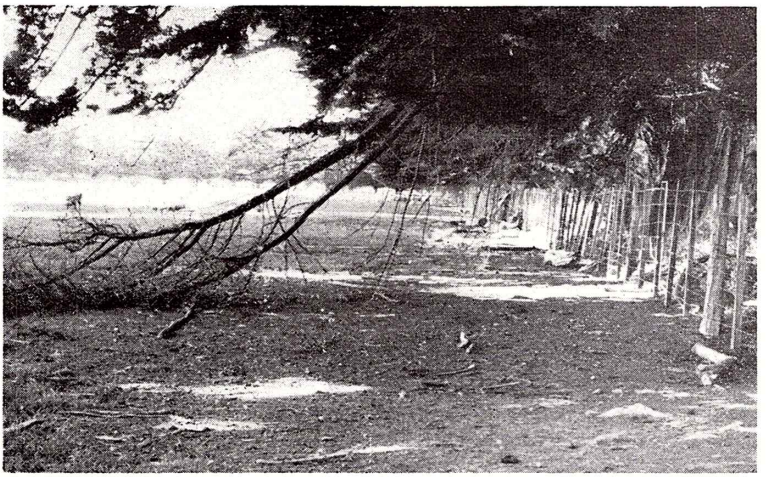


Photo by Dr J. S. Yeates.

An old, badly managed macrocarpa shelterbelt which has resulted in a strip of ruined pasture and fouled ground about half a chain wide.

STRUCTURE

It is often said by farmers that their land is too valuable to waste up to 5 to 10 per cent. of it in wide, shady belts. If wide ill-conceived rows of mutilated pine and macrocarpa were the ideal of what shelter should be, then the writer would be inclined to agree. However, of recent years, overseas research with wind-tunnel and field measurement has revealed that the most efficient shelter is provided by tall, semi-permeable belts on a narrow base. It has also been demonstrated that the wide wind-proof rows, so hard to attain, are conducive to quite high turbulence even at a very short distance away. Farm forestry associations have adopted as their ideal a belt that will give maximum shelter over the entire pasture so that stock and pasture are protected. Well-sheltered grass will grow more successfully; well-sheltered stock have no need to go to the shelter trees for shade or shelter and thus fertility is not transferred away from the pasture.

The ideal is a tall two-storey belt of good elite timber type trees which can be underplanted with shade-bearing hedges or trees. Such belts can be grown on a 9 ft base with grass and sun getting to the very roots. Wide conifer belts, on the other hand, often extend over 90 ft to two chains with the shade their wide-spreading branches cast over the bare, germ-ridden soil beneath. A 22-year-old macrocarpa which was measured recently had branches which extended 45 ft from the trunk.

Contour can also aid efficiency in shelterbelts. Thus trees planted on the windward side of a rolling spur can really shoot the wind upwards and for a long way. Belts planted in sharp dips on flat or rolling country can form most efficient windbreaks.

To summarize therefore, plant across the wind with as tall and narrow a belt as possible and intersperse this with the odd dense, single-row tall belt.

SPECIES

From the foregoing it will be seen that the tall, erect-growing elite trees, such as the N.Z. Forest Service uses for its seed collection, are the ones needed for the good, high shelter, while the second storey will be of a shade-bearing species, either as a trimmed hedge, coppiced tree, or one suppressed by the overhead branches. There are many interesting mixtures here. Such tall trees of good pedigree will give a crop of valuable saw logs or even peelers, whereas trees like Lombardy poplar, though admirable as shelter, can present an expensive problem of disposal when over-mature. Mutilated pine and macrocarpa, similarly, can be most expensive to clear up and give most indifferent shelter while covering great widths with unhealthy shade where weeds establish. A mile of erect timber trees of well-selected poplar, pine or eucalypt, trimmed to 20 ft at an early age to allow for the growth of the second-storey trees, could well be worth, at maturity, £1,000 per mile at four trees per chain. The ultimate, then, is the tall, narrow belt with some trimming of lower branches so that the sun can sweeten the grass at the base and some wind can filter through the middle height. Such belts at, say, 12-chain intervals will give good shelter over the whole pasture, and any transference of fertility to beneath the trees will be avoided. The stock will be quite happy out in the middle of the pasture.

With high-pruned shade trees of poplar, plane, or eucalypt, etc. placed at strategic points on rises and providing shade, no bare spots need occur and any transfer of fertility by stock will be spread over a wider area and washed down the slope.

High-growing top-storey species for well-drained coastal sites

Fortunately most coastal land is well-drained. At present there seems little better than radiata pine for such sites. It has weathered in coastal fore-dune planting remarkably well and is possibly the best for the job. Norfolk pine

(*Araucaria excelsa*) is quite remarkable on such sites and is being tried out near Opunake by the Taranaki farm forestry group.

High species for wet coastal areas

Wet coastal areas are difficult propositions, the plains near Palmerston North being an example. Conifers, of course, are out. In the north, *Eucalyptus botryoides* is the standard tree with *E. ovata* for peat areas. Shelter in such difficult sites seems to resolve itself into a gradual build up of height in the first line of defence, say, phormium, pampas or cabbage trees, backed by shrubs like karo or large-leaved privet with tolerant trees behind. *Populus bolleana* could be worth trying in spite of its suckering habit. Behind this belt more useful poplars or eucalypts could be tried. For under-planting, pampas, phormium, privet, etc., could be used. The poplar-pampas belt can be a stock saver in times of severe drought, an edible belt which will not suffer from such treatment as cutting down to ground level to regenerate.

High species for well-drained inland sites or internal belts

(1) Radiata pine (*Pinus radiata*) trimmed of lower branches.
(2) Poplars on moist, non-acid soils with some pruning. *Populus robusta* and Italian hybrids I (for Italian) 30, I.78 and I.455.
(3) Eucalypts: *E. botryoides* and *E. saligna* (warm), *E. cladocalyx* (cool) and *E. delegatensis* on the high inland areas.
(4) Douglas fir (*Pseudotsuga taxifolia*).
(5) Larch (*Larix* spp.) and poplars for protection against southerly winds.

Species for low lying (not coastal) areas

(1) Poplars: *P. robusta, P. eugenei,* I.30, I.78, I.455.
(2) Eucalypts: *E. botryoides* (warm), *E. ovata* (peat and cool).

Some underplanting species for well-drained soils

(1) Japanese cedar (*Cryptomeria japonica*) or *C. elegans.*
(2) Mexican cypress (*Cupressus lusitanica*) or its variety (*C. benthamii*).
(3) Western red cedar (*Thuja plicata*).
(4) Redwood (*Sequoia sempervirens*) (with eucalypts on deep soils).
(5) Boxthorn and barberry.
(6) Eleagnus (if the farmer likes it).

Some species for single-row belts

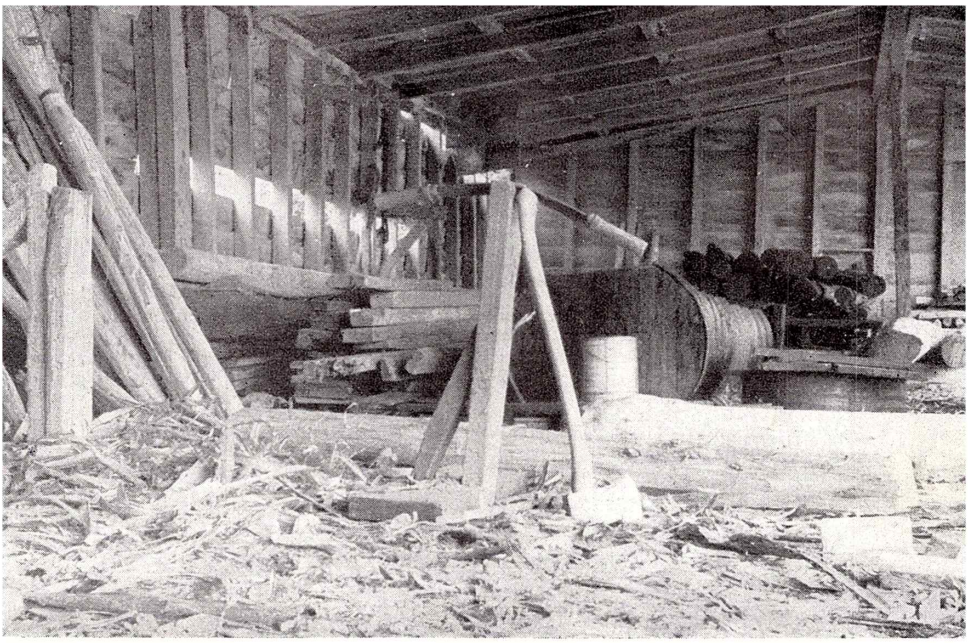
(1) Japanese cedar.
(2) Mexican cypress.
(3) Redwood.
(4) Bhutan cypress (*Cupressus torulosa*).
(5) Western red cedar (on moist fertile inland soils).
(6) Incense cedar (*Libocedrus decurrens*).
(7) Atlas cedar (*Cedrus atlantica*) (which is more erect than deodar (*C. deodara*)).
(8) Arizona cypress (*Cupressus arizonica*); this and the cedars are suitable for drier country.
(9) *Populus robusta* and larch (for a screen against southerly winds).
(10) Douglas fir (on inland well-drained sites).
(11) Leyland cypress.

These are all tall, erect trees, free from troubles like canker, etc. Trees subject to diseases have been omitted. A short description of each species is appended to this article.

The Small Woodlot

The home preservation of farm timbers has increased the importance of the small woodlot to farm economy. One acre of a suitable treatable timber species, say, radiata pine, will produce about 200 posts or 2,500 battens per year. Total cost of cutting, peeling and treatment with cold soak creosote is under £20 per 100 for posts and 25s. for battens.

Posts can be cut, preferably early in the summer, and peeled smartly either with a spade or peeling knife. In some districts contractors will peel by machine for £3 per 100. Posts should be open-stacked, on a hill top preferably, and when dry either covered or brought inside for some time as this final drying aids absorption greatly. Various types of baths have been used — old cream vats, cut down end-welded drums, etc. Some means of checking absorption by fixing levels is necessary and each post when extracted should be checked individually. It will usually be found that, if posts show an overall retention of half a gallon each after soaking, there will have been about a quarter of a gallon taken up during the filling and fastening down of the load before the initial level is set. About three-quarters of a gallon per medium-sized post is adequate. With well-dried posts it will be difficult to keep retention down to this even in eight hours' soaking, so 40 per cent. waste oil could be added.



A farm forester's cold soaking plant for peeled eucalypt posts made from 44 gal drums welded together for longer material and 44 gal drums sunk in the ground for butt and top cold soaking.

For battens, pine should be well-dried after sawing, and then bundled with baling twine. By soaking about 10 minutes, sufficient creosote is absorbed to be adequate for a good, long life. There are records of posts and battens done by this method being perfectly sound after 35 years. Treatment by such oil-bound preservatives applies only to pine timbers and perhaps poplar or white pine. Very well-seasoned macrocarpa can be done with long soakings.

For battens and home-sawn timber the diffusion method using Bolit salt or Osmosar can be used. This is a cheap, quick method and will give good results with hardwoods and difficult conifers like the cypresses.

If the property is within reasonable distance of a pressure-treating plant and the farmer owns a truck, it may pay him to cart the dried posts and battens for treatment. There are two formulations used in such plants, Tanalith and Boliden. These are multi-salt, water-bound preservatives of which the main ingredient is arsenic. Such salts become fixed in the timber with chemical action and, in accelerated tests, have shown up well and are now accepted by the Timber Preservation Authority for a life of 30 years in the ground. Some of the earlier salts used have given some failures but it is contended by the proprietors that the latest formulae are good and it does look as if this is so. If any one has records of excessive failures in lines of

treated posts, the N.Z. Farm Forestry Association should be notified and, in turn, the Timber Preservation Authority. In some cases, excessive amounts of non-treatable heart woods are responsible, especially in Douglas fir and larch.

Prices for treatment vary from district to district according to the competition, but the general charge is £14 per 100 for posts of medium size and £1 for battens. With cost of transport added, the saving on commercial treatment costs is fairly good but not nearly as good as that obtained by doing the work on the farm.

The woodlot need not form a sombre background to the homestead, near which it is best sited, for by planting colourful flowering and foliaged trees around it, the whole surroundings can be attractively lightened. Radiata pine will no doubt form the basis for short-term fencing timber needs, and should be planted at 6 ft spacings to give a first crop at about eight years until about 20, when the posts will become too "hearty" and therefore difficult to treat. (It is a weakness of many commercially-treated posts that they have far too great a proportion of heart wood in them which is almost impossible to treat.) Some initial roading of the block at planting time is always helpful to post extraction. In extraction it will be found best to extract from the middle towards the road always — a simple rule but an important one.

For a longer-term rotation for posts, some will wish to plant the naturally durable species and, of these, the best would probably be *Eucalyptus muelleriana, E. scabra, E. tereticornis* (the recently changed name for *E. umbellata*), *E. microcorys* (tallow wood), *E. botryoides* and *E. pilularis*. (The first three will stand most sites in the North Island except the central areas.) Redwood and western red cedar are the only reliable durable conifers and are worth planting on good, deep, well-drained loams, like those around Taumarunui and the East Coast, for instance. Redwood will stand warmer climates but western red cedar needs a cold one. The cypresses are too unreliable in the ground and need some treatment; then they are really excellent.

There are specialized markets for the farm forester in handle timber, veneers and timbers for furniture and joinery.

HANDLES

An Australian research officer who specialized in strength tests of timbers, gave the following list in order of his preference:

(1) Bodalla wattle (*Acacia sylvestris*).
(2) Hickory.
(3) Spotted gum (*E. maculata*).
(4) Ash (*Fraxinus excelsior*).

The N.Z. Farm Forestry Association has seed of the very tough, quick-growing Bodalla wattle and it is being tried out. It could be a much needed timber.

ROTARY VENEERS
(1) Poplars: *P. robusta*, I.30, I.78 and I.455.
(2) Pine.

SLICED VENEERS
(1) Tasmanian blackwood (*Acacia melanoxylon*).
(2) *Eucalyptus saligna, E. botryoides* and *E. regnans.*

FURNITURE
(1) Walnut.
(2) Tasmanian blackwood.
(3) *Eucalyptus saligna, E. botryoides, E. regnans* and *E. obliqua.*

JOINERY
(1) Pruned Mexican cypress and Bhutan cypress; also macrocarpa (*Cupressus macrocarpa*), though this is subject to canker.
(2) Western red cedar.
(3) Redwood.
(4) The ash-type eucalypts: *E. regnans, E. delegatensis* and perhaps *E. fastigata* are good working, relatively mild, joinery timbers.

Farm forestry associations are hoping to have a prototype portable tractor sawmill designed and made shortly. This will be a great help to back-country farmers in the efficient use of their timber trees, saving double cartage to distant mills. By sawing timber efficiently on the farm, and with good marketing, returns can be tripled, even near populated areas. The need for safe, well-designed plants, preferably with a moving table, should be emphasized as the common table bench is very dangerous with small lengths and is a decided hazard. The associations have done good work also in helping to get stumpages up to reasonable rates for good timber. A handy area of good 30-year-old trees, where all-weather extraction is possible, should be worth £400 as a basis, with descending scales according to distance from market and difficulties in harvesting. In some areas it is possible to obtain £1 and more for a decent sized shelterbelt tree of reasonable form. Good shelterbelt trees are easy to harvest and are worth money. Often the reason

why they are difficult to sell is that millers persuade farmers to give their trees away for the clearing, and thus queer the market for others.

The Farm Plantation

A tended farm plantation of well-selected trees is a decided asset on any farm:

(1) It is non-taxable for death duties.

(2) No lending institution will lend money on it while growing, which is a good thing because its value, unlike that of livestock and wool at times, stays intact.

(3) It does not have to be sold immediately like lambs and wool and thus can be left until needed in times of recession or for other needs such as death duties. One estate assessed recently needed a very substantial sum for death duties and the whole amount was met by the sale of trees. Another large place, with about half its area in trees and pasture, is in the lucky position of having the trees carry along the farm. It will probably be the first of many that will be in such an enviable position. The North Island needs another crop, and trees could well be it.

(4) Trees will transform a non-productive area to one of quite high return. There are many areas on farms in some districts, notably Northland, East Coast, Hawke's Bay and parts of Taranaki, where weeds and manuka are most costly or even impossible to eradicate within the farmer's financial ability. Such areas must run at a loss if they cannot carry more than a ewe to the acre and are a drag on the more productive parts of the farm. If trees are planted on such areas, it is, of course, some years before any return starts to come in — up to 25 to 30 years if thinnings are not saleable — but, once the rotation starts, the land will carry its full share of production. For instance, sited handy to a good market, these poor areas can return a profit of £10 per acre, per year, net — *i.e.*, with establishment costs, interest, rates, pruning, etc. deducted, and the timber sold on the stump.

From the foregoing it can be seen that trees are an aid to good farming. Farm foresters are farmers first. They use the returns from their trees to bolster their farm income — *e.g.*, to put on more manure when prices otherwise would dictate that they put on less; to provide money and material for more and cheaper fencing and to leave a backlog there for times of financial stress and difficulty. They may even do what C. W. S. van Kraayenoord suggested in the 1961 *Sheepfarming Annual* (p.95) — plant an acre

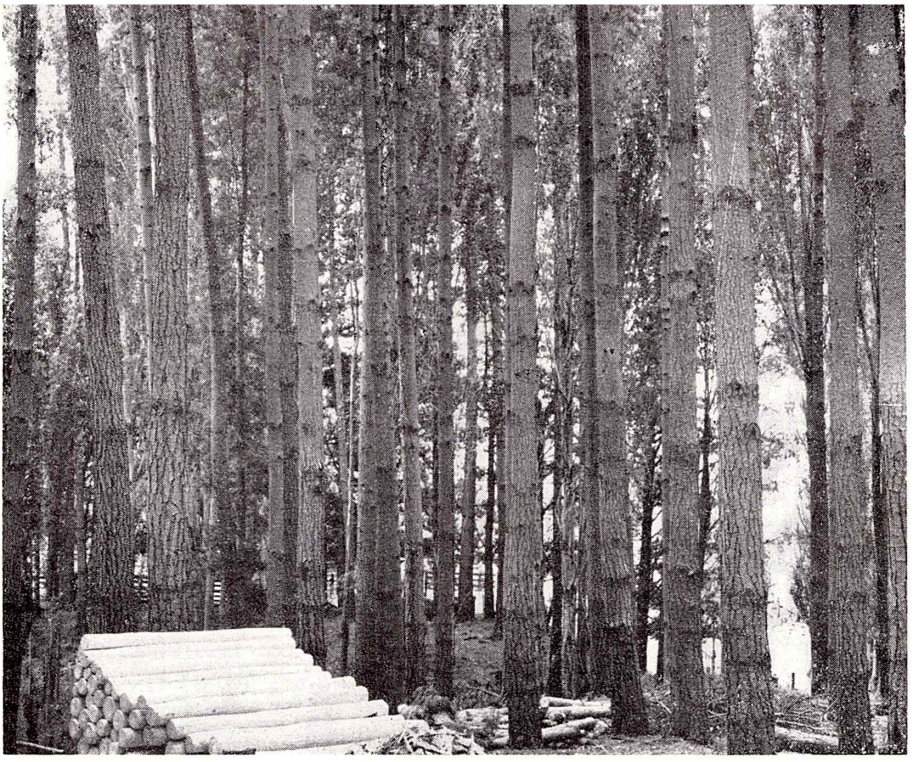


Photo by J. H. Johns, N.Z. Forest Service.

"A tended farm plantation of well-selected trees is a decided asset on any farm."

or so of poplars (or eucalypts) to provide the wherewithal for their daughters' weddings. The difficulty with this scheme is that trees mature at 30 and daughters at 20, so one cannot altogether be prepared. However, it is wise to begin early, and a few suggestions might be offered to young farmers on how to go about planting a sizeable area of trees for profit.

The Minister of Forests recently announced a very sound loan scheme for tree planting in which £25 per acre is lent to fence and plant an approved area of trees; approved in that the site has to be good and in a timber-hungry area. It is also stipulated that trees have to be from seed of high quality, preferably that gathered by Forest Research teams from the top trees of good stands. Pine and Douglas fir will be the main species to be considered but possibly poplars and eucalypts of a few versatile and stable species will qualify later. Once the area has been established, half of the loan (£12 10s. 0d.) is written off as a suspensory loan. Interest is charged at 3 per cent. (simple not compound) plus 2 per cent. for insurance. At about ten years or so, another loan is granted for the thinning and pruning to about 18 ft of the remaining trees. Thinnings can be sold if there is a market (usually for posts, but possibly for

pulp in some areas) and this money used to pay off the loan. Once this job is done, another £7 10s. 0d. is written off so that, in all, £40 per acre is lent and £20 written off as a suspensory loan.

It is hoped that once the scheme commences in about a year's time, contract gangs of good planters working under a trained forester will be available to do the job right through. Forest Service contract rates will form a basis for negotiation. It is better that the job be done outside the farm labour pool, as in most districts labour is difficult. Nurserymen may take on the job and have their own gangs.

A minimum area of five acres and a maximum of 20 acres per year is fixed, but 100 acres can be planted in one year at five-year intervals. If a farmer has land available, he should write to the nearest Forest Service office.

However, if it is felt that the job can be done without help, money will be advanced to do the fencing as needed, to buy the trees, and to pay the wages of the planter, even if he be the owner.

The sites given priority will be those:

(1) In areas where it is estimated there will be a future shortage of timber, or where there is one already. Such areas would be the Wellington area to be serviced by Wairarapa and lower Hawke's Bay; Hawke's Bay and Gisborne, where timber will be needed for local requirements, and because this area would be conveniently placed in an export scheme; most of Northland, say, from Kaikohe south, and Coromandel, to supply local needs and to service Auckland. The far north where a large sand reclamation area has been started could well be a natural for export timber on a large scale; Taranaki with its rich sites on steep southern slopes could well grow high-quality species, as could areas like those around Taumarunui and the King Country. Such inland areas would need to grow high-quality species to stand the costly railage to the main centres or ports.

(2) In areas where pulp timber is needed to augment the supplies of the large paper-making plants. Such areas as those in the Bay of Plenty and the central plateau would be considered. It may surprise many to learn that the large paper-making concerns can apparently see the end of their reserves even though they have vast forests of pine behind them. Tasman Pulp and Paper Co. Ltd. is buying large areas of land to plant and N.Z. Forest Products shows signs of looking for

extra reserves. This is because they are stepping up their plants to turn out more paper, an excellent earner of overseas exchange and dividends. It is considered that, once their plants are extended, both concerns will swing over from timber to increasing amounts of paper and pulp production and this will be a contributing factor to the shortage of timber that is estimated in about fifteen years' time.

Under the terms of the loan scheme, spacings will be conventional, probably 9 ft × 6 ft. Such details are covered very well in publications written by W. H. Jolliffe and put out by the N.Z. Forest Service. Pruning and thinning will be conventional, too, but there may be some short-cuts and cost savers incorporated. It will be realized that, while up to 900 trees are planted, only about 120 form the mature crop. To get maximum growth, thinning has to be carried out at the correct time. Timber quality is degraded by knots, especially dry, bark-encased ones, and so it is necessary to prune branches off to leave the minimum of knotty core. Trees well-pruned and thinned, to allow only green branches to grow on top, will be worth about twice that of those in unthinned stands by virtue of the thinnings being used before they rot and the clear and good grades obtainable from the final crop trees. There is no need to work on every tree; only about 150 of the best trees should be pruned. This can be done in the early stages with long-handled pruners or low-pruning saws. The initial pruning may be done at about six to seven years to about 8 ft, and the final pruning done with a pole pruning saw to 18 ft. When all this is done the plantation can be forgotten, except in the dry season, and the final return awaited.

It is helpful to bulldoze tracks up valleys at planting and at intervals around the contour to aid extraction of thinnings. Lines should always be straight up the contour as logs are always easier to pull out either up or down the grade.

Under the loan incentive scheme there will be little choice of species. Some farmers, however, may prefer to organize their own plantations and try some of the lesser-known species that may have special appeal. There are, for example, the poplars so ably discussed by C. W. S. van Kraayenoord in the *Sheepfarming Annual 1961*, pp.95–105. These are more suited to open farm land and have a very promising future for many needs. New Zealand imports about £90,000 worth of poplar annually as match splints. Poplar makes a very fine veneer, and grows more quickly than any other tree in New Zealand.

In some well-favoured inland areas, the redwood could well be considered in fairly large areas but the soil would need to be uniformly deep and good. It needs early and careful pruning. In such sites, the western red cedar could well be grown also. Possibly seed from some of the warmer southern states of America would be of advantage. This is the timber imported for sashes, etc. It grows well in inland Southland where rainfall is good.

The cypresses are not really the trees of the large plantation — rather those of the woodlot. They involve tricky establishment and a lot of careful pruning. They can be used to advantage for underplanting some more light-demanding species such as the eucalypts.

Larch in both species, European and Japanese, never seems to be a tree for large-scale planting. Its market is limited and the timber is often difficult to season.

With eucalypts there is always the tendency to over-diversify for there are many interesting species. In large-scale work it is wise to stick to the best timber species, which might be summarized as:

(1) *E. saligna, E. pilularis* (blackbutt) for the warmer areas.
(2) *E. delegatensis* and *E. regnans* for the colder areas.
(3) *E. muelleriana* which could perhaps fill a place in warm to intermediate climates, say, down to Wairarapa and Feilding where it is growing well.

All these eucalypts are timbers of very high quality, highly regarded in their own country, and should be used more in New Zealand for flooring, clear-grade strong timbers, veneers, mainly sliced, and structural hardwood. All are used for pulp in Australia and some are being planted by N.Z. Forest Products for mixing with radiata pine for high-grade papers.

There is, however, need for special thinning schedules for this genus, as it is possible to grow only about 60 large trees per acre and these need to grow steadily without much check from overcrowding, or else they will give trouble in sawing. Spacings can be much wider initially, say, 12 ft × 12 ft. First thinning down to 200 per acre would probably be done at 10 to 12 years and thereafter saw-logs taken out as the trees suppress themselves, until the final crop of, say, 50 remain at about 20 years. Some underplanting can be done with shade bearing species, *e.g.* Mexican cypress, western red cedar (under *E. regnans* and *E. delegatensis*), to take up the bottom story if the trees are to be left on a long rotation.

SOME NOTES ON LESSER KNOWN TREES MENTIONED

INCENSE CEDAR (*Libocedrus decurrens*)

This Californian tree is, in the main, easily transplanted, and grows quite fast, being very wind-firm in its early stages. It is a long-lived tree with an erect form. This is one of the most promising of new trees tried for shelter work. It appears to be fairly resistant to salt winds in early planting. Its timber is durable and is used mainly for pencils. Seed is available from New Zealand Forest Service.

LEYLAND CYPRESS

This is a hybrid between *Cupressus macrocarpa* and *Chamaecyparis nootkatensis*, and grows easily from cutting. It is dark green, uniform in growth, not unlike Lawson cypress (*Chamaecyparis lawsoniana*), and could well replace that species. Leyland cypress is reputed to be disease-resistant. A new recently imported clone of this hybrid promises to be superior to the one already here.

BHUTAN CYPRESS (*Cupressus torulosa*)

Unlike most cypresses, this is a good transplanter, rather slow away but on this account very wind-firm in its early life. It is a tall, fairly narrow-based tree with attractive grey-green foliage. This tree also is disease-free. Seed is obtainable from New Zealand Forest Service.

MEXICAN CYPRESS (*Cupressus lusitanica*)

This is the species from which the variety *benthamii* derives. It is, however, a much more erect tree, though prone to blow over early in a belt. It has a much superior bole to macrocarpa for timber, without the buttresses associated with this latter species. Its timber is somewhat lighter and softer than macrocarpa but is nonetheless very valuable for joinery and various uses. Good seed sources are known by the Forest Service. Seed will be available from trees of imported selected Mexican seed. This tree should not be confused with Bentham cypress (*Cupressus benthamii*) which is wide-spreading and variable.

JAPANESE CEDAR OR SUGI (*Cryptomeria japonica*)

This is a well-known tree easily procurable from nurserymen in good quality. It has one drawback in that the leaves tangle with the wool of sheep and cause trouble. It coppices when cut down which is sometimes an advantage. It needs a well-drained, even soil as it is very apt to be uneven in growth on clays of mixed moisture content.

JAPANESE CEDAR (*Cryptomeria japonica* var. *elegans*)

This is a lower, softer-foliaged variety of the species with a reddish colour in winter. It is a good underplanting tree, especially under poplars.

ARIZONA CYPRESS (*Cupressus arizonica*)

This is rather variable as a species in this country but, as it will grow from cuttings under special conditions, the best erect, blue forms should be propagated. It is especially suitable for dry country.

ATLAS CEDAR (*Cedrus atlantica*)

This is one of the true cedars which is most suitable for shelter work, taking up less ground and being faster growing than deodar (*C. deodara*). Both these species are good, dry country trees, though deodar is the better timber tree. For timber growing there should be careful selection of seed.

SUGAR GUM (*Eucalyptus cladocalyx*) is a colder country species, used a lot in shelter work in Victoria where it is often grown in double rows which are coppiced alternately at six-year intervals. It gives good timber for posts. Seed could be obtained from the N.Z. Forest Service or seedlings from nurserymen at Dannevirke or Pahiatua.

Eucalyptus regnans and *E. delegatensis* (syn. *E. gigantea*) are two of the ash group eucalypts — *i.e.*, they have a light-coloured non-durable wood, not unlike ash. These are both good, cold country trees growing right down to Southland and will do especially well on similar country to that around Taihape. Seed of *E. delegatensis* is obtainable from the New Zealand Forest Service.

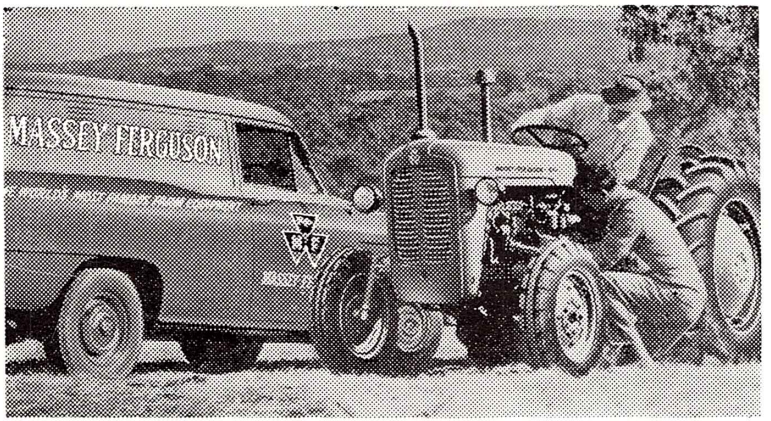
DISCUSSION

Q : : *Could* P. radiata *pine battens be better treated with creosote or some other preservative rather than Bolit salt or Osmosar?*

A : : Pine battens can easily be treated with creosote. They will need drying first, and then about 5 minutes' soaking will often give the ¾ gal/cu. ft of creosote necessary to give a good long life. Creosote does tend to lubricate the staples which is the disadvantage. However, ungalvanized staples of the larger size stay in well. Battens treated with water-borne salts hold the staples quite well if the timber is dense.

Q : : *As macrocarpa lasts longer in the ground, it ought to be more widely used than* P. radiata *pine. Why is this not the case?*

A : : In the preservation of posts it is the timber which takes up the preservation reliably that matters. Pine sap, especially that of radiata, is one of the best for this. Macrocarpa is not a generally reliable timber in the ground although some strains give good life. It is a very hard timber to penetrate with creosote but it can be done after some years of seasoning — it then makes a good, strong, light post. Macrocarpa treats well by diffusion with Bolit or Osmosar.



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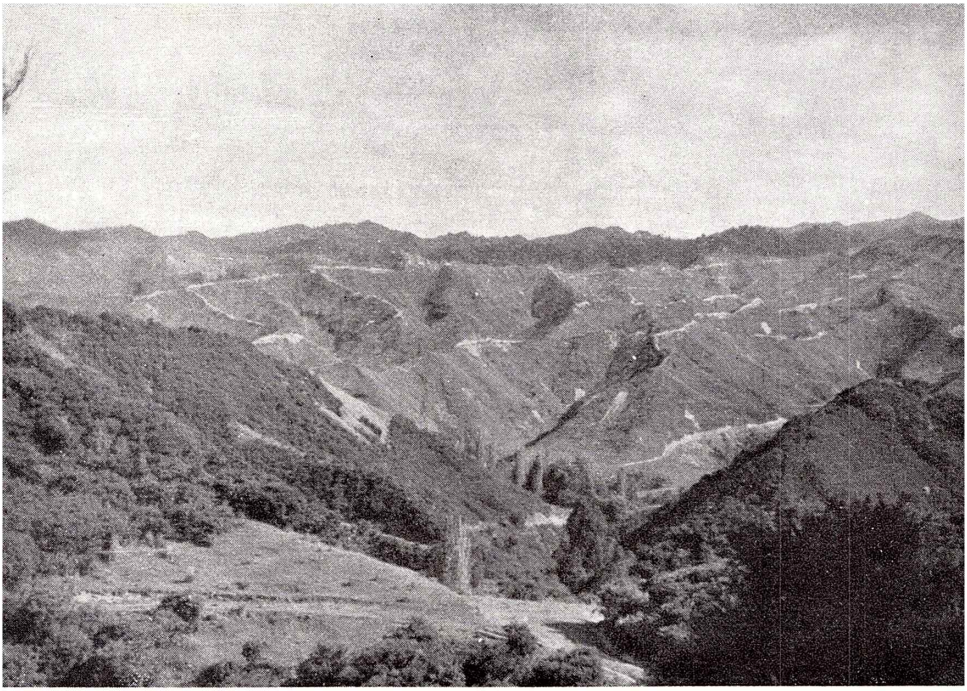


FROM MANUKA TO GRASS ON STEEP HILL COUNTRY

K. R. MARSHALL*

THE PROPERTY to be described is one of 4,688 acres and is only 17 miles inland from Wanganui, on the Parihauhau Road. Situated across the central head of the Parihauhau Valley, it is split up into many valleys by the numerous branches of this stream and a majority of the slopes face into the south. Along its southern boundary there are several hundred acres of rather sandy country, otherwise the formation is basically mudstone, with papa dominating. The altitude ranges from 300 to 1,500 ft but most of the country lies between 400 and 1,000 ft. The annual rainfall is about 50 in.

The property was purchased in 1956 for £5 per acre, and has since been run as a company, "Parihauhau Livestock Ltd". It was divided into 11 main and 24 lesser paddocks and only nine of these were reasonably stock-proof.

* *Makirikiri Post Office, via Wanganui.*

Manuka was there in thousands of acres. Some 2,400 acres of it was real "old man" manuka, up to 40 ft in height in the gullies. About 1,600 acres was of mixed manuka and grass, with the manuka infestation varying from light to heavy. Some 350 acres of gorse, 250 acres of bush, and 100 acres of flat or semi-flat land in reasonably good pasture completes the picture.

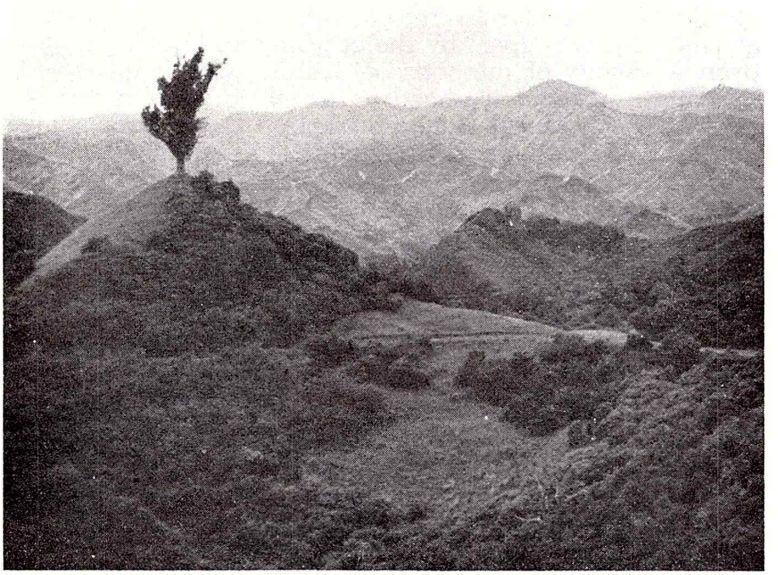
When purchased, the property wintered 2,900 sheep and 220 cattle, and the production for the first year was 1,400 lambs docked and 72 bales of wool.

The property was purchased with the idea of developing it as rapidy as possible, financed out of income. With rapid development in mind, in conjunction with some reductions to mortgages, the task was undertaken with the idea that first priority must be given to clearing the land and getting grass established, thus increasing the stock carried to give further profits to plough back for still further development work; fencing, tracking, bridging, gorse spraying, etc., could come later. Time would compel the spending of increasing sums on these later tasks and, therefore, if the speed of improvement was to be kept up, it was necessary to boost the gross return fast.

It was originally hoped to have the place all in grass in six years, but this time is now up and there still remain two years' work to complete. This was not due to miscalculation, however, but to lack of finance owing to the steady fall in meat and wool prices over the period concerned.

So much for six years ago. What about today's picture? Although not completed, the development work is well under way. The total area in good pasture is now about 4,100 acres and the production of livestock has greatly increased. Last year (1961) 8,000 sheep and 400 head of cattle were wintered. Four thousand lambs were docked and 80 calves marked. The 1961–62 wool clip was 207 bales. This year 2,100 lambs were fattened; because of the drought, this was 500 less than last year. Four to five hundred wethers and about 35 bullocks are also fattened annually. Because of the sandy soils and lack of lime, the 5-year-old ewes are not usually good enough in the mouth to sell as breeders so they mostly go to the freezing works.

Old pastures are improving. Manuka is fast losing the battle but gorse is more tenacious. An airstrip, with a bin for 250 tons of bulk superphosphate, has been built. Bulldozed tracks total over 30 miles, and most of the 40-odd miles of fences are reasonably sound. Wool weights are improving as topdressing increases. Mortgages have been heavily reduced. And, as an interesting aside, to show what



General view of the type of country cleared. The highest peak, Pukewhahariki, 1,507 ft, can be seen in the right background.

sheep farmers have experienced in the way of falling prices over recent years in spite of stock and wool production nearly trebling, the gross financial return has not yet doubled!

Variegated thistles are common in the district and have proved costly and time-consuming to control. Up to 70 acres per annum have been sprayed by helicopter and up to 120 man-days per year have been spent on this weed. It comes thickly on parts of the scrub burns and in scattered patches over older pastures. One spraying, plus digging of scattered plants, just about finishes them on a burn, but on some of the older pastures they keep coming nearly as bad year after year. However, on the whole, this weed is being slowly beaten.

Two areas with a lot of bracken fern were burnt over and sown in conjunction with manuka burns, and were then fenced off with waratah standards and old wire, using the cheapest battens available, such as split willow. These fences had to hold cattle for three years and were then demolished, the fern having been completely destroyed by dry cattle in that period.

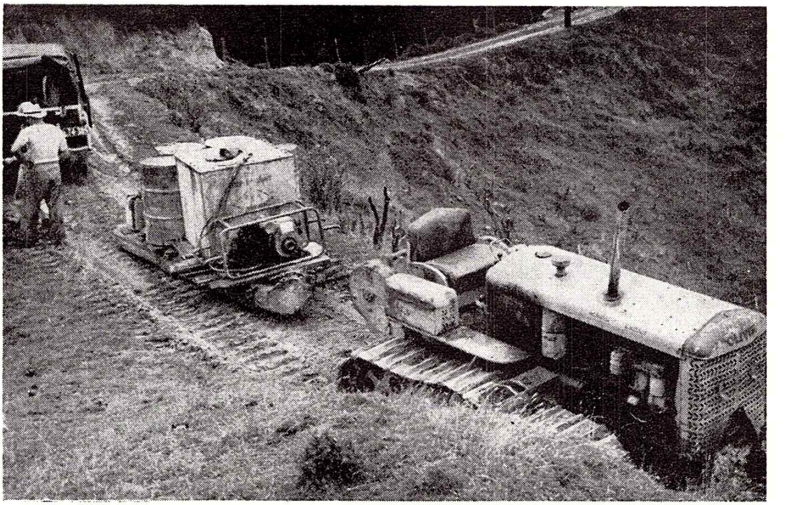
Gorse, however, has been a really tough hurdle. In addition to some 350 acres of gorse in one block, there has proved to be nearly as much again under the standing

manuka. Held under by the manuka, it was just waiting the chance it was given by the cutting and burning of this cover. A variety of methods of dealing with it have been tried and untold advice has been received from experts — and others — on what should be done. Various things have been tried, including spraying with 2,4,5-T or CS 301, using helicopters, ground sprays, fire, slashers, stock, and employing Hindus to cut the gorse and paint the stumps with 2,4,5-T. The only sure kill is to cut it and paint the stumps, but this is far too expensive except for very scattered gorse. This method ousts grubbing completely.

On the first manuka burn of nearly 600 acres, considerable areas of gorse were soon established. Eighteen months after the burn, 170 acres were sprayed by helicopter. That proved a costly job which did little but delay the gorse and, at the time, seriously discouraged thoughts of using helicopters for this work. Later experience, however, showed that the error was not in the use of the helicopter but rather in the time of spraying, because one thing learnt about gorse on this property was not to spray it when 18 to 19 months old. Twice a helicopter was used and for three years in succession ground crews were employed to spray considerable areas at this age; in no case was the result satisfactory. Recently men who should know have said that 21 months was a good age to spray. It may be, but on this property it is a mistake to spray at 18 months. At six months and at 30 months, good results from both helicopter and ground have been obtained, but it has not been tried at 21 months.

At present heavy stocking with sheep after the burn is being experimented with and this method shows promise. Burning it green was found to be unsatisfactory as the resultant burn is not good enough to enable the sheep to get at the young gorse. To cut and burn is ideal, but too expensive, as it would cost up to £20 an acre. At a cost of £10 per acre, the gorse can be sprayed from the air during the summer, and if left until the following March a hot fire and a good seedbed can be expected. This would appear to be the best preparation for the control of gorse with stock. One area was burnt and sown this March, fifteen months after being sprayed, and it looks as though it may be possible to control it with stock.

The original 170-odd acres of gorse that came up on the first big manuka burn is now definitely on the way out. Much has reached the stage where it is economical to cut and paint the stumps with 2,4,5-T or CS 301, and once this stage is reached the gorse is beaten.



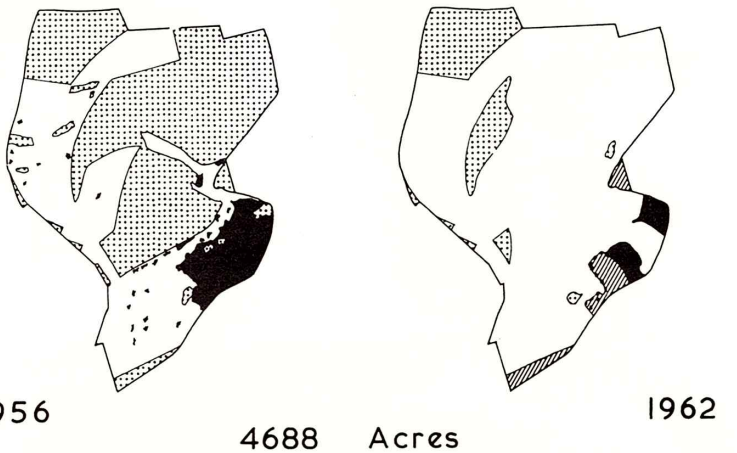
Bulldozed tracks total over 30 miles, about half being used only for gorse spraying access.

The block of 350 acres of gorse on the property, when bought, was on some of the better hills and, for that reason, presented a different problem from the gorse that comes up after manuka burns. In the latter case, some two-thirds of the gorse is on the poorer and steeper areas, owing no doubt to easier establishment among the more open type manuka found there. This fondness for steep places, gorge edges, etc., adds considerably to the difficulties of getting at gorse for spraying, and aircraft cannot reach it satisfactorily in such areas.

The sole reason for about half the bulldozed tracks on the property is to get at the gorse on these hills. Some serve several purposes, such as access for stock work, and to get men and materials to fencing jobs, as well as for gorse spraying. But many have no exit and are used for gorse spraying only.

Water is necessary for spraying gorse from the ground. All told, 12 high-level and several low-level dams have been constructed to give water for spraying and for stock. High-level dams are especially valuable for both purposes. Three of these are at an altitude of about 1,200 ft.

Widespread in New Zealand before farming began, manuka has a great aptitude for taking advantage of man's clearing of the bush cover on hill country. It has a very small seed, produced in vast numbers that must often run into millions per plant over the sixty-odd years that con-



Comparison of cleared and uncleared areas after six years. Manuka infestation shown by dotted areas and gorse by solid areas.

stitutes the life of a manuka plant. The tiny seed is readily blown about by strong winds, and is carried by stock, wild animals, water, man and dogs, and also no doubt by birds. The plant commences fertile seed production when four years old. The seed matures by January and, under normal conditions, falls from about April to the following spring. If, however, a plant is scorched by fire in, say, February, it can shed its seeds within a week. This means that, when manuka is burnt standing, a vast number of seeds are sown over the newly-burnt area and, as that is ideal for the germination of manuka seed, it can readily be seen how disastrous it is to burn manuka standing.

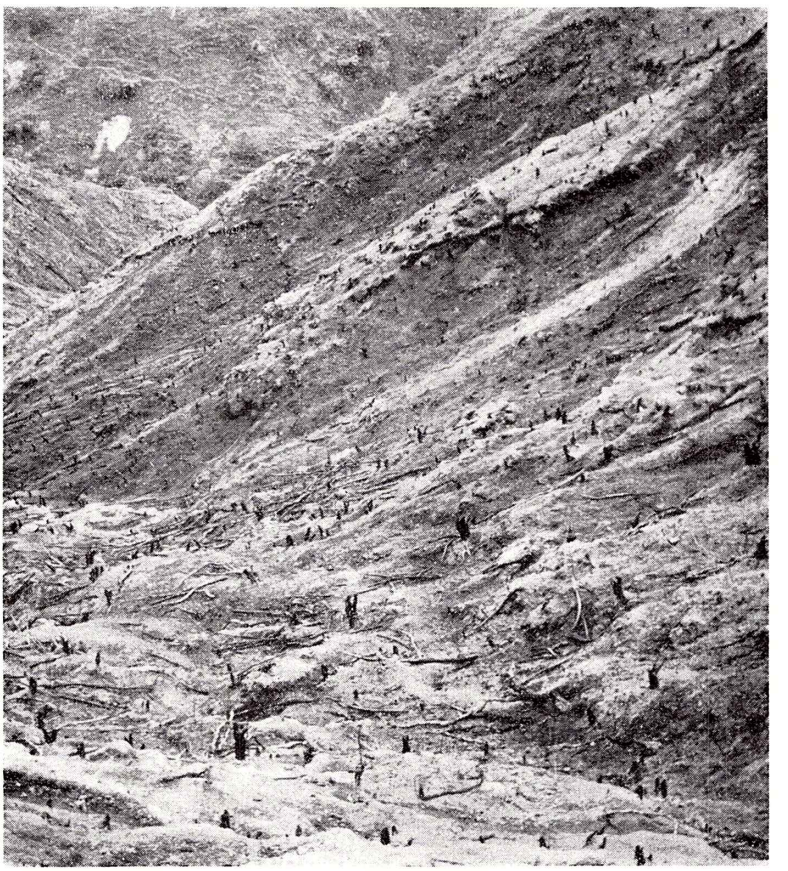
Under normal conditions, however, the percentage of seed that germinates and reaches maturity must be very low indeed. A good sole of grass is a strong deterrent to the establishment of manuka, owing to its need for light when the seed first germinates.

On an undertaking such as that being tackled at Parihauhau, one of the most important tasks was to avoid new burns being sown, by wind, with quantities of manuka seed. If this could be prevented, it is believed that a long and expensive job cutting re-infestations of small manuka would be avoided. A glance at the 1956 map (above) shows a semi-isolated block of manuka, centrally situated on the property. Nearly 600 acres in area, this was the first target, chosen because it was surrounded by semi-grasslands, over which it could spread seed endlessly. But more important

still, from these grassy areas, only a very limited amount of seed could blow back over the area when it was burnt.

The reasoning here proved sound and, after a good January burn and a good strike of grass (sown by Tiger Moth), time has proved that only on permanently wet spots on shady faces did any manuka grow, and in such small quantities that one man cut all there was over an area of nearly 600 acres in ten days.

After this initial job, the bulk of the remaining heavy manuka was in one large block and it was concluded that, as the prevailing winds are westerly, the right course was to begin on the west and work eastwards year by year,



Burning should preferably be left for six months after cutting of heavy growth.

felling away from the entire length of the previous year's work as soon as possible after it was burnt. This cutting back from the burn must be done each autumn before the seed begins to fall. The policy was followed for four years, with success for three of them. For three years the only regrowth on the burns was an odd plant on the wet spots. But in 1960, in June, when the manuka seed was falling, a three-day gale from the east succeeded in blowing a lot of seed right over the protective belt that had been felled along that summer's burn. It was known at the time what the result would be and, sure enough, a close inspection next spring showed a heavy infestation of manuka seedlings along the eastern side of the 1960 burn. The area affected was about 80 to 100 acres and the infestation was heavy on the eastern boundary of the burn and tapered off to the west.

This occurrence proved beyond reasonable doubt the wisdom of felling away from the prevailing westerly wind and showed how easily all the burns could have been sown with manuka seed if the job had been done the wrong way.

So much for heavy manuka. Lighter growth presents a somewhat different problem and must be dealt with accordingly. Whereas the heavy growth is best left lying for six months before burning, six weeks is ample for lighter growth cut during summer. But the principle of the hottest possible fire being the best still applies, as does the rule of avoiding seed blowing over new burns. Here, too, consideration must be given to spread of seed by stock, since cutting part of a paddock of mixed grass and manuka would cause stock grazing among the uncut areas to carry seed on to the burn. Even with this attention to detail, the result will not be as good as a hot fire on a block of unbroken heavy manuka because, generally speaking, more seedlings will come up where scattered growth has been cut and burnt. Along the lower edges of patches that give only a light fire, the heat will not be great enough to kill seed lying on the surface; but such a fire will let in the light and enable seedling manuka to establish.

In cutting manuka too light to burn at all, it is inevitable that many small plants will be missed, especially if the job is done during the summer, and if the grass is rank. The plants may be two years old but only four or six inches high. In view of the fact they could bear fertile seed two years later, it is necessary to cut over such areas at two-year intervals to stop seeding of plants completely. Two or three such cuttings will give nearly 100 per cent. elimination if seed is not coming in from outside sources.

In the case of the property at Parihauhau, there are roughly 300 acres that are subject to heavy annual wind-borne re-infestation from neighbouring farms to the west. There is nothing for it but to cut over this area every second year indefinitely. However, heavy topdressing and oversowing with clovers and careful stocking to obtain the best possible pasture will be a big help in keeping this job down to a minimum.

In conclusion, perhaps something should be said of the economics of this undertaking. First, if the original purchase price is added to the sum it cost to develop the property, the figure obtained is far and away above the present value of the land and stock it carries. This looks bad. But the other view gives a very different picture. It is this. The only capital put into the company was £12,000 cash and about £1,700 worth of livestock, after which everything done has been paid for out of income, and the shareholders' interest in the company now far exceeds the original capital.

DISCUSSION

Q : : *What seeding and topdressing rates were used on the burns?*
A : : The seed mixture used was white clover, suckling clover, *Lotus major*, subterranean clover, crested dogstail, browntop, and both Italian and perennial ryegrass. The rates of application varied from 10 to 20 lb per acre, depending on whether the burn was a very heavy growth or not, as in the latter case a good deal of grass comes naturally after a burn. Topdressing rates varied from 1 to 2 per cent. per acre — admittedly light but this was governed by economics.

Q : : *Has erosion occurred on the farm and will it increase in the future?*
A : : Severe erosion occurred on this and all other hill properties in the district during last August's severe storm. After this erosion should decrease, not increase, in future.

Q : : *How did you find enough labour to do all the work on the farm?*
A : : By paying good wages, knowing that local labour becomes available in winter and spring, and by employing Hindus both to cut scrub and find more employees.

Q : : *Is it better to spray gorse some time before burning it rather than spray the re-growth following the fire?*
A : : That depends on the intended method of future control. If it is intended to spray as a follow-up, I would suggest burning the standing gorse first. It attempting stock control, I would spray heavy gorse before burning.

Q : : *Was gorse spraying effective in the drought as well as during wet weather?*
A : : It appears to have been, but a final answer cannot be given until next summer.

Q : : *Was a "sticker" added to the hormone used to kill gorse?*
A : : No.

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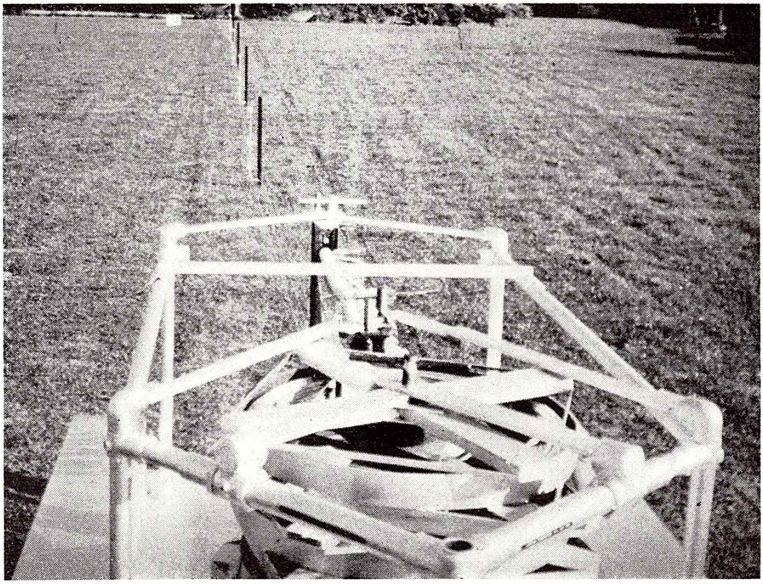

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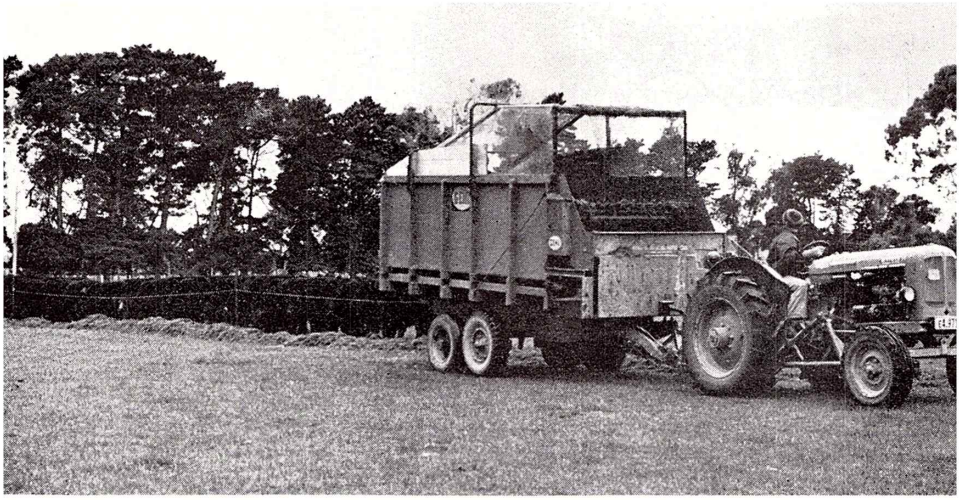

A NEW APPROACH TO FATTENING BEEF CATTLE

R. B. GIBSON*

THE TITLE, "A New Approach to Fattening Beef Cattle" is, perhaps, a misnomer for a scheme which was started in August, 1961. Briefly, it was planned to feed cattle by cutting choumoellier and grass with a forage harvester and transporting and unloading it into troughs with a self-unloading trailer. This system is, basically, as old as farming itself but is one which in New Zealand has not been considered necessary or desirable with the abundant grass growth available.

Sheep farmers tend to regard this abundance of pasture growth as something of a problem at times of the year when the sheep are unable to utilize all the grass which is available.

As a ram breeder, with a comparatively light stocking of young sheep which cannot be made to eat that grass which most needs eating at any particular time, the fattening of beef cattle is an integral part of the writer's farming programme. Over the years, however, it has been irksome to see high-producing pastures continuously eaten down by cattle to the point where those pastures make their slowest growth. This method of continuous grazing cannot be reconciled with known facts about grazing for maximum grass production. For this reason, a system was aimed at which would allow the grass to reach its maximum growth rate and yet avoid some of the troubles which accompany grazing under such conditions.

* *"Beckfield", R.D. No. 7, Feilding.*

The attitude of many sheep farmers towards beef cattle is: "We must have them to keep the grass down. If a cash profit results, so much the better; but even if no such profit results, the cattle have done a good job of grass control and helped in the fertility build-up".

Vigorous pasture growth in the spring and early summer is the result, in part, of high fertility which has cost a lot to build up and maintain. If this growth is used in its early stages, the pasture does not get the chance to produce at its maximum rate. Therefore, it would appear that the prevalent idea of stocking up in the spring to keep the grass short constitutes planned restriction of pasture growth.

Outline of the System

By allowing the grass to grow, it was hoped to feed considerably more cattle from a given acreage and still have a good, balanced pasture in the following autumn, a crucial period for a ram breeder.

It was not anticipated that the cattle would fatten more quickly under this system. One could hardly hope to have cattle thrive any better than they do under free spring-summer grazing conditions. However, under such free-grazing conditions they become very selective grazers. If they are mob-stocked on successive paddocks to control surplus grass, a large amount of wastage is involved, and there is fouling of pastures. On the other hand, if this surplus is not controlled, the well-known general deterioration in pastures takes place.

It was not intended to go over to "zero-grazing", as it is called overseas, but to try to use some of the better features of that method on a scale which would be big enough to enable an assessment of results, yet not sufficiently large to upset the usual farming routine.

The farm consists of 600 acres in the Kiwitea district. Four hundred acres of this is absolutely flat and remains remarkably dry even in the wettest winter. It also has the ability to retain moisture in a dry summer. There is almost 2¾ miles of road frontage — an important point. In the spring and summer, cattle stocking varies from year to year. The maximum has been 600 head, or one beast per acre during October, November and December.

Broadly speaking, the reasons for embarking on this scheme were:

(1) To obtain better utilization of crop and pasture.
(2) To prevent fouling of pastures and subsequent encroachment by undesirable plant species.

(3) To minimize the effects of selective grazing.
(4) To get some advantage from the more rapid growth rate which occurs when a pasture reaches the height of three inches, or more.
(5) To make it possible to buy in cattle at a more favourable time — *i.e.*, to avoid the rush in late September which is normal in this area.
(6) To have a buffer to counteract some of the effects of possible overstocking should dry weather set in.
(7) To get more production from some of the special-purpose pastures on the farm which are costly to put down and maintain.

However, the point uppermost was the better pasture utilization which appeared likely. Information available showed that it is theoretically possible, in New Zealand, to produce, from grass alone, 750 lb of animal liveweight increase per acre per year. Experiments carried out in recent years have shown that top pasture does not often produce more than 250 lb of meat per acre, or an approximate liveweight increase of 550 lb.

It seemed reasonable that a different approach to feeding could give as good, if not better results than merely trying to produce more grass. It could possibly be cheaper in the long run. In other words: Why produce more grass when what grows already is not utilized fully?

Inevitably the question of transfer of fertility had to be considered. At the outset, this appeared to be a fairly big stumbling block but it was decided that, as the intention was to use only a small proportion of the total acreage, no permanent harm would be done even if no system of reciprocal fertility transfer could be worked out. It was intended to cut feed from a paddock only once during the season.

Briefly, what was to be taken off in one season would be put back during the next. While it was realized that this could be over-simplifying things, it was felt that no big problems would occur.

The points for and against the scheme as seen at that stage were:

FOR THE SCHEME

(1) Grass could be allowed to grow at its maximum rate; this was the most significant factor.
(2) All the grass cut would be utilized.
(3) Cutting would ensure that the whole pasture area could be brought back to a uniform length.

(4) To a large extent encroachment by undesirable grasses could be minimized.
(5) The resulting regrowth should be vigorous and produce a well-balanced pasture.
(6) Theoretically, at least, a greater number of cattle could be fed without jeopardizing the sheep in any way.
(7) In the case of winter crop, choumoellier in particular, full advantage could be taken of the very high per-acre yields which are normal in the area.
(8) By using green crop in the early spring, a comparatively large number of cattle could be started along the fattening road many weeks earlier than would be normal.
(9) Buying-in could be done before or after the annual rush.
(10) Stock, sheep included, could be fed a fattening or maintenance ration as desired.

AGAINST THE SCHEME

Although the disadvantages were mainly uncertain possibilities, this did not reduce their importance.

(1) The cattle might not react favourably.
(2) The water supply and distribution might not be adequate.
(3) The tractor might not be capable of operating the machinery in wet conditions on the choumoellier paddock.
(4) A mechanical breakdown in the early stages could be disastrous. There would be no alternative feed available at that stage.
(5) A late spring could put the scheme badly out of gear.
(6) If the scheme proved to be impracticable, the farm would be left with equipment which, although useful, would not be economic if used in any other way.
(7) In the event of failure, one's pride would be dealt a severe blow — a not insignificant point when many very efficient farmers were watching proceedings with a somewhat cynical eye.

After correspondence with farmers overseas who were zero-grazing dairy herds had brought reassurance on some of the doubtful points, it was finally decided to start the scheme in 1961. In the light of subsequent experience, the choice of year was the one big mistake.

Equipment

The choice of a suitable forage harvester presented difficulties because of the wide variety to choose from and variations in prices. The machine had to fulfil the following requirements:

(1) It had to be a fully offset machine.
(2) It had to be capable of towing a self-unloading trailer which could weigh seven tons fully loaded.
(3) The delivery chute needed to be movable.
(4) It had to be capable of cutting almost any crop from a height of seven feet down to three inches.
(5) Service and spare parts backing had to be above average.
(6) It could not be a direct-mounted machine owing to the frequent hitching and unhitching which would be necessary.
(7) A low horse-power requirement in relation to cutting width seemed desirable.

Finally, a double chop type was chosen and, although expensive — £695 — it has proved to be a very efficient machine and has given no trouble. The rear towing hitch was wrongly placed but this trouble has been overcome in a way which would horrify the designer.

The other major item was the self-unloading trailer. These machines are available at a cost of approximately £1,100. However, a kitset of American manufacture was eventually bought and the machine built on the farm. In this way, the cost was reduced by nearly £500.

Feeding troughs were built to measurements recommended by an American farm journal but were made only 10 ft 6 in. long so that they would pass through a gateway when loaded crosswise on a trailer. Also, in the event of the scheme failing, the troughs could provide useful gate-timber. Two hundred feet of troughing was built, sufficient, it was thought, for about 160 head of two-year-old steers.

Feeding Plan

The feeding plan was as follows: Of a 16½-acre paddock of choumoellier, four acres would be cleared to provide standing room for the cattle. The remaining 12½ acres would be fed to the cattle along with hay as a supplement. When this choumoellier was finished, grass cut from an autumn-sown temporary pasture was to be used and from then on a succession of grass paddocks were to be closed up at suitable times to ensure that adequate and worth-

while feed would be available at the right time. The first grass paddock was to be topdressed with 3 cwt of nitro-lime and closed up on August 1, the same day on which a start was to be made on feeding choumoellier to the cattle.

It was planned to use areas which were due for ploughing as sacrifice paddocks, bearing in mind their location and adequacy of water supply.

Care in planning the future feed supply was very necessary. There were many considerations to be taken into account:

(1) Varying growth rates as the season progressed.
(2) Provision of shade or shelter during the transition from spring to summer.
(3) Varying water requirements.
(4) The size of paddocks closed would have to be varied in line with the expected pasture regrowth rate at different times of the season.

By late June everything appeared to be in order, so it was decided to feed the early lambing ewes with choumoellier cut and carted from the first four acres which were to provide standing room for the cattle. This would serve three purposes. It would provide an opportunity to remedy any unforeseen deficiencies in the machinery; it would be a big help in assessing the yield to be expected from the choumoellier crop; and it would be an interesting experiment in the feeding of in-lamb ewes.

It was an unqualified success. Four hundred and sixty-five ewes were fed with the chopped choumoellier from four acres for five weeks. The daily ration was approximately 10 lb choumoellier and about ½ lb second-grade lucerne hay per sheep. Excellent stock health was maintained throughout. The choumoellier, very finely chopped, was fed directly from the wagon on to a grass paddock in the form of a long windrow and the amount wasted was negligible. All of the stalk was used. The year's crop was barely 3 ft high and sown in 14-in. drills — a light crop by any standards.

(This makes an interesting comparison with the feeding of crop by the on-off system. The previous year, using this latter system, it took six acres of a very heavy crop to feed a smaller mob for a shorter time. At the same time the not-unusual epidemic of eye-blight spread rapidly.)

The only complication was that, as soon as the tractor and trailer entered the paddock, the sheep surrounded it in their eagerness to get at the choumoellier, and completely immobilized the whole operation. It was necessary to have the shepherd on hand to keep the sheep clear.

An important point is that the services of a knowledgeable and enthusiastic tractor driver, keen to make the scheme work, were available. His enthusiasm for the job was invaluable, and did not wane at any stage.

During the last week of July the cut and uncut areas of the choumoellier paddock were divided by an electrified barbed wire and the troughs set up in such a way that the wire would prevent the cattle from damaging them. One hundred and fifty-five steers were purchased in three groups — 68 forward two-year-olds, 66 store two-year-olds, and 21 very forward, but not big, three-year-olds.

The daily ration decided upon was 150 lb of choumoellier and 8 lb of hay per steer. This was estimated to be about 3 per cent. of liveweight on a dry matter basis. Assuming that the crop was not growing, this could be expected to last for 36 days or a little longer.

By weighing a couple of loads, it was established that the wagon would carry about five tons per load, but there were some doubts about the tractor's ability to handle it. It was not desired to use an extra tractor and driver — in fact, it was thought advisable to reduce the cattle numbers, if necessary, to ensure that the feeding would not require more than one man's work twice daily.

On August 1, the 155 steers were put in the sacrifice area which was quite dry. By the end of the day they had become "educated" by the electric fence and were timidly nibbling at the feed. Sooner or later wet weather would come and it was only hoped that it would not start until a little more space for the stock to live in had been gained.

After about four days, most of the cattle were feeding well but a few were reluctant to get into the "scrum". However, by the end of the week, all were feeding, trough space was adequate, and the tractor was coping quite easily. When all the cattle were feeding they presented a very fine sight.

On checking previous estimates, it seemed likely that the crop would yield to expectation. Cutting and feeding took about 45 minutes twice a day and it was obvious that the ration was more than adequate. The hay was being fed under the electric fence and hardly any was wasted. Very little water was being used.

During the second week things took quite a different turn. It started to rain — and continued to rain. In a very short time the four-acre sacrifice area was just a sea of slosh.

The immediate reaction was to give the cattle more space but this was decided against on the grounds that

it would only be a matter of hours before that, too, became muddy. If better weather conditions were awaited there would be a chance that the fresh ground would stand up to the tramping. This policy was later justified; but the conditions were very worrying while they lasted.

On reflection it appears that all this mud worried the cattle very little; they continued to feed well and did not show any real preference for the drier areas. Nevertheless, it was difficult to accept the fact that the muddy conditions were just part of the scheme.

Meanwhile, cutting operations went quite smoothly. Wheel strakes were used for three or four days and on one occasion the tractor became badly bogged owing to the fact that the drawbar jack on the wagon ploughed into the ground. Fortunately there were no spectators that day. The scene created by two people trying to clear away chopped choumoellier as the wagon unloaded it within a few feet of one electrified wire, with 155 hungry cattle milling around, was one which could be fully appreciated only by a cartoonist.

When the weather improved the electric fence and troughs were moved across the paddock, and ground conditions became much better.

After three weeks it was possible to take stock of things. Some of the lower-conditioned cattle seemed to be making slow progress, but the forward cattle were thriving. Trough space was by now inadequate — a sure sign that they were, at least, gaining weight. However, at this stage they were not rushing the feed, but had settled down to a routine of feeding and resting throughout the day. The ration was more than enough; often there was feed left in the troughs from the previous day.

By September 11 the choumoellier supply was exhausted. Twelve-and-a-half acres had lasted 155 cattle for 42 days — six days more than had been anticipated.

The next step was to change the diet to grass from the 16-acre paddock which had been closed on August 1, six weeks earlier, and topdressed with 3 cwt of nitro-lime. It had attained a height of 10 inches, but owing no doubt to the heavy rains early in August, had not responded to the nitrogen as well as had been expected.

About eight tons of grass were fed daily and the cattle could make it disappear in a remarkably short time — they much preferred grass to choumoellier. A fresh sacrifice paddock was used and after about one week the mob was reduced to 125. It was considered advisable to draft off a few of the cattle which did not seem to be thriving, also

a few who would insist on climbing over the troughs in spite of the electric fence.

By September 26, all of the grass from the first grass paddock had been cut, having lasted for 14 days — two days less than the estimate. Another young grass paddock of 13 acres which had been closed to cattle on September 5 was then used. Forty ram hoggets, or three per acre, had been left on this paddock. It was estimated to last one week which, in fact, it did.

September had been a month of cold, south-westerly winds and growth was very slow. By the end of the month it became apparent that this slow growth was going to upset the timetable. However, the first grass paddock had made a remarkable recovery in spite of the weather conditions — at one stage, in a sheltered area, it grew at the rate of four inches in five days. The sward was noticeably thinner, however. Despite the original decision not to cut any area more than once, it was found necessary to do so, even though there was not enough regrowth from which to cut six inches of grass. It had been found that anything less than a total height of nine inches was uneconomic because the forage harvester tended to scatter the grass rather than pick it up.

On the second cutting, the 16 acres lasted only one week. During this week two steers died and the veterinary surgeon was unable to establish, definitely, the cause. Blackleg was suspected but never confirmed — bloat was ruled out entirely.

In view of the risk of further deaths, and while waiting for a report from Wallaceville, it was decided to put the cattle out to normal grazing for about three weeks. This spell would also give closed paddocks a chance to catch up.

These cattle were never put back to trough feeding. Many of them had reached the killable stage and it was felt that it would be better to purchase another line for feeding at a time appropriate to the feed supply.

On October 10 when feeding for the first group finished, another eight-acre paddock was closed up and the second grass paddock, which had been cut once, was left with only a light sheep stocking.

At the end of October the feeding of a second line of 108 two-year-olds was begun. The two grass paddocks had produced a colossal amount of regrowth and it seemed likely that there would be no serious shortage.

On November 12 another seven acres were closed up and on November 20, 15 acres more.

By mid-November it was obvious that the dry weather was having an effect on growth and trouble was expected if drought conditions were to set in. They did.

While it appeared reasonably certain that the cattle could be fed, it soon became apparent that some of the saved grass would dry off and the feeding value would deteriorate. This did, in fact, happen and although the cattle were fed to capacity right through to January 25, they barely maintained condition during the last month.

Early in the planning stage the idea had been considered of growing six acres of maize as an insurance against drought conditions but, as droughts are fairly rare in the district, the idea was abandoned. It is now realized how valuable such a crop could have been.

The last 15 acres had become no better than poor standing hay. The decision to carry the programme right through to this date was made solely because of the drought conditions. The original plan had been to revert to normal grazing in mid-December and any saved grass not used was to be made into hay.

There remained the choice of selling on a depressed market or carrying on. This was one of the situations which had been considered in the early planning. The opportunity to put this aspect of the scheme to the test had certainly arrived. Needless to say, the dry weather was not expected to continue through to March. When it did, the penalty was paid, as was the case with most farmers.

Results

(1) FEED UTILIZATION

Results when feeding choumoellier were much as anticipated. Virtually nothing was wasted and 12½ acres of a light crop of choumoellier, estimated at about 18 tons green weight per acre, fed 155 cattle for 42 days, with a very sparing hay supplement. By comparison, in the previous year 112 steers were put on 16 acres of a very heavy crop. Though given all the hay they could eat, they had finished the choumoellier in less than three weeks. Most of it, of course, was tramped into the ground.

The 16-acre grass paddock which was closed up on August 1 and fed off during September and October was equivalent to grazing 49 cattle or 3 per acre over the 72-day period.

Another eight-acre paddock was ungrazed for 58 days in October and November (the best growing months). It fed 108 cattle for 23 days which is equivalent to carrying 42 cattle over the 58-day period, or 5¼ per acre.

(2) EFFECT ON PASTURES

Pastures all recovered remarkably well, being noticeably denser in the dry weather than those which were grazed in the normal way. There was no fouling and at present it appears that encroachment by foreign grasses has been reduced. Carrying capacity of these paddocks in the autumn was much better than that of those which were hard-grazed during the summer. The one exception was the temporary pasture which now consists entirely of clovers. This result could be attributed to the drought.

(3) CATTLE RESPONSE

Cattle did not put on condition any quicker than they normally would; but spectacular weight gains were not expected. A few did not take to the system at all and were drafted out. However, killing weights always seemed to be better than the appearance of the cattle indicated. A typical draft was one killed on November 28 after 10 weeks of trough feeding and three weeks' grazing, in which 9 small three-year-olds averaged 620 lb dressed carcass weight, and 15 two-year-olds averaged 563 lb dressed carcass weight. These are not remarkable weights, but the younger cattle were small, and even when prime would not be expected to do more than 600 lb.

Generally speaking, the cattle did well while feed quality was good and not so well when the quality fell off. It was not possible to compensate for poor quality by feeding more.

It was noticed that the bullying which is apparently common in dairy herds did not occur with these steers.

(4) GAIN FROM EARLY BUYING

Owing to the poor spring growth in the area, the panic buying which usually takes place in September was not as intense as usual. However, two-year-olds such as were bought in late July were about £2 per head dearer at Feilding in September. Other years have seen this disparity reach £5 per head. When the second draft was bought any mild rush to purchase cattle which there had been, was definitely over.

(5) BUFFER AGAINST OVERSTOCKING

In this particular year over a hundred cattle would have had to be sold before Christmas if there had not been saved-grass and the means to use it to advantage. What advantage was eventually gained by holding the cattle is a matter for conjecture.

(6) EFFECT ON SACRIFICE PADDOCKS

The only unexpected result came when these paddocks were sown to grass or crop. The choumoellier was sown to temporary pasture in September and the area which had been badly pugged produced only weeds — very little grass seed germinated. Similarly, the grass paddock, which was pugged only where the troughs stood, produced nothing on that strip when sown to kale. Some germination came later on this strip but in the main it was bare ground. The crop, however, is a bumper one over the rest of the paddock.

Another area, which was not ploughed, recovered quickly and has carried a heavy stocking of sheep and cattle through the autumn.

(7) TIME AND LABOUR INVOLVED

Seldom were more than two hours per day used and, except when troughs were moved, one man did all the work. However, for efficiency, the operator needs to be more than just a tractor driver. It must be remembered, also that it is a seven-day-a-week job and a relief driver would have to be available.

Problems Encountered

From time to time small problems cropped up but none that really upset the overall scheme.

The electric fence had to be kept alive all the time. If the ticking of the unit stopped, it was the signal for the cattle to push under the wire and create havoc on the wrong side of the troughs.

In a high wind it was necessary to travel into wind when cutting grass otherwise a good deal was lost. This took extra time.

When cutting choumoellier, it was not always possible to use the full width of the machine because of the power required. If the speed over the ground was too slow, the cut material was almost pulp. It is no job for a 30 h.p. tractor.

Conclusions

The writer is satisfied that this method of feeding is basically sound but is not so sure that it has been put to the best use. There are many possible alternatives; some of them, in the light of experience, appear to have definite possibilities.

The experiment in the feeding of in-lamb ewes gave remarkable results — never, on the farm in question, had so many sheep been fed for so long, so easily, and from such

a small area of green crop. The crop need not have been choumoellier. The method could be used with cereal crops, saved pasture, or a mixture of the three.

Rather than fatten cattle, better value could perhaps be derived from the system by aiming at maintaining cattle through the winter on a smaller ration.

Another point worth noting is that the self-unloading trailer can handle almost any feed except hay. With hay wafering not so very far away, this exception could be eliminated.

When a quick and efficient method of shifting chopped silage from pit to wagon is found, the system should hold even more interest than it does at present.

DISCUSSION

Q : : *Why did seed sown on the pugged area fail to germinate?*
A : : It has been suggested by people I have consulted that there was an excess of nitrogen, but I think this is ruled out by the results on areas which did not pug although subjected to the same heavy stock density and for longer periods. I am quite sure in my own mind that soil structure was temporarily destroyed, and with it, the normal capillary action which is responsible for moisture distribution. However, I am not a soil scientist and would not care to be too dogmatic.

Q : : *What is the interval between ploughing the "sacrifice" paddock and sowing it to a green crop?*
A : : In this particular season it was about 2½ months. It is our normal practice to plough well in advance of the sowing of a green crop.

Q : : *Is the capital outlay involved in all the machinery needed for feeding your stock warranted?*
A : : In the first place, I do not consider the capital outlay to be high. £1,400 would have covered all of my expenditure. After feeding the early lambing ewes I calculated that the machinery, if only used for six weeks annually to feed 450 ewes, would pay for itself in five years, owing mainly to the saving in crops needed. I did not attempt to calculate the return expected while feeding cattle. As the whole scheme was untried, any results expected were too uncertain to be used as a basis for calculations.

Q : : *Would it not be better to feed the ewes chopped choumoellier and let the cattle graze over the whole of the farm?*
A : : The whole idea of the scheme was to utilize the vigorous spring and summer growth of grass by feeding cattle. The fact that we fed in-lamb ewes so easily and economically, was, as far as I was concerned, a side-effect — albeit a very good one.

Q : : *Would it not have been preferable to feed the cattle on the less fertile land rather than on the most fertile areas?*
A : : On our farm there is no difference between one area and another, so we used as sacrifice areas those which were expected to experience a depletion of fertility during the following season as a result of crop production. We were limited to some extent, in that sacrifice areas used during the summer had to have shade and a plentiful supply of water.

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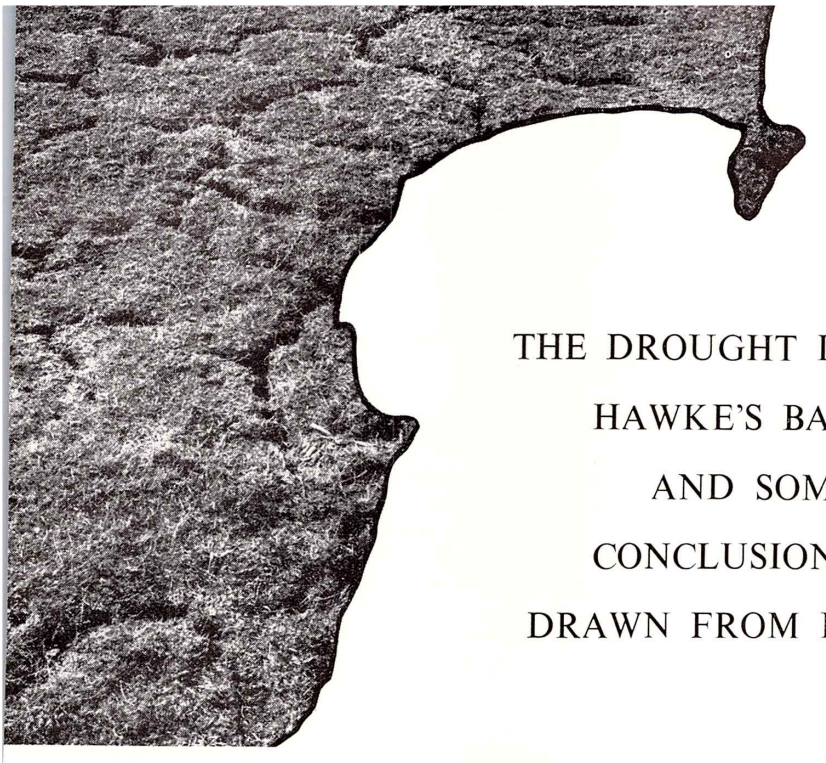

THE DROUGHT IN HAWKE'S BAY AND SOME CONCLUSIONS DRAWN FROM IT

F. H. COLLIN*

CENTRAL HAWKE'S BAY has always been recognized as a "dry climate" farming area. This is well illustrated by the varied types of farming undertaken in the province. It is predominantly a sheep- and cattle-raising district, with many droughts since the province's first sheep made their coastal trek from Wellington to Pourerere 113 years ago. Dry spells have usually been at expected times in the summer, between December and January or through to April.

Early Droughts

This year's drought has undoubtedly been the worst recorded for almost fifty years, but never have Central Hawke's Bay farmers suffered a drought as disastrous as that of 1913–15. With no Welfare State to come to their aid, no motorized transport to freezing works, and no quick disposal of stock at saleyards, farmers burnt piles of dead sheep and cattle. Native grass, poor water supplies, lack of supplementary feed, a lack of killing facilities, the absence of fertilizer topdressing, would all be main contributing factors to the disaster which farmers quote from time to time.

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Since then the district has had many droughts. Older farmers will remember the dry years of 1921–22, 1925–26 and then 1930–31, when only 25 in. of rain was recorded, 1938–39 with 21 in., and 1945–46 with 22 in. Those were all exceptionally dry years with prolonged dry summers, but they were not of a really disastrous nature.

The annual rainfall in Central Hawke's Bay ranges from 27 in. to over 80 in. Droughts are mainly confined to the low rainfall areas (27 in. to 32 in. belt) where the farmer must farm for and expect dry seasons. Dry conditions usually develop gradually, allowing a farmer to dispose of surplus stock as a dry season progresses, or make provision to hold stock by cropping, or by utilizing surplus spring growth, such as hay or silage, if he has some arable land. With better farming techniques, many farmers have adjusted their policies accordingly; they have also made more provision for water supplies, fencing subdivision, better species of grasses and clovers, and more correct fertilizer topdressing.

This Season's Drought

One may ask the question: "How is it that this season's drought has been such a disaster to areas in Central Hawke's Bay?"

Farmers refer to this dry period as a "freak" one. Not only did it affect the farms in the low rainfall belt but it was even more disastrous in areas which expect an annual rainfall of up to 60 in. The far-reaching effects of this drought really stemmed back to the winter of 1961, when the farms were well stocked up following three wet summers, and no exceptionally dry periods for some years. The cattle build-up resulted from these good seasons which trapped many men into carrying too much stock for the normal Hawke's Bay dry season — some probably got the impression that the increased use of fertilizer and their better management had improved their farms more than they actually had. The district on the whole experienced an excellent growing autumn and most farms went into the winter with ample feed, and the usual minimum reserve of hay and crop. The more progressive farmers on the lowland country also had supplies of silage.

Last year really was freakish. The winter and early spring were the wettest on record, then from October to January it was one of the driest. The area worst affected was the coastal belt from Hastings to Porangahau and inland to Waipawa and Waipukurau. Much is moderately steep to

hilly, rolling country, with pockets of flat land. Over the past years approximately 60 per cent. of that country has been ploughed or giant disced and sown to permanent pasture, 30 per cent. has been oversown with clovers and topdressed regularly and the remaining 10 per cent. has been left in unimproved native pasture. The soils are mainly silt and clay loams on a clay subsoil.

The coastal district was not the only area affected by the abnormal climatic conditions. The mid-district hill country and flats also suffered quite badly and capital stock had to be disposed of. The estimated area affected by the drought in Central Hawke's Bay was some 850,000 acres — not including the area affected in Woodville and Dannevirke counties.

Some areas that normally have an annual rainfall of 40 in. recorded 37 in. in July, August and September, practically a season's rainfall in three months. In other 60 in. annual rainfall areas, over 69 in. fell in three months. On this clay subsoil, hill country one can well imagine the state of the top soil and pastures under fairly heavy stocking rates. Pugging was inevitable and slipping and slumping occurred with the result that many of the smaller catchment stock water dams silted up, leaving only a depth of 3 ft to 4 ft of water. Erosion was widespread and a number of farmers described the condition of the soil as "porridge". On the rolling and flat country it was soon realized that drainage was of paramount importance. At least farmers had a reasonably dry area to feed out winter hay reserves, which by the spring had been practically depleted. Despite the extremely wet winter conditions, little surplus stock had been sold and farmers generally were looking forward to holding and fattening stock with the expected flush of spring feed.

From October onwards there was a succession of hot, cloudless days with strong north-westerly winds. The surface soil dried off and baked like concrete, consequently pastures made little or no growth. This occurred over much of the province and created a huge problem for many farmers. They were unable to close paddocks for hay or silage. Cultivation was held up. Large tracts still had oversaturated subsoil. Those areas of lighter country that were sown to supplementary crops were failures owing to the dry conditions.

Surplus stock now had to be disposed of, more particularly cattle, but, as the supply exceeded the demand, values soon dropped. Surplus sheep followed in the wake of cattle and all killable lambs were sent to the freezing works.

Because of the seriousness of the dry conditions, it soon became apparent that farmers would be forced to dispose of capital stock. An approach was made to the Minister requesting that a Drought Relief Committee be set up to assist farmers in the drought-affected area. Cabinet approved of the standard forms of relief, together with a special dispensation to farmers for a taxation adjustment on the forced sales of stock.

To hold capital stock, the Committee arranged for cattle to be grazed on Crown Lands in Hawke's Bay and on private land outside the district. Some 14,000 head were sent to outside grazing.

Cattle feed was non-existent, stock water supplies were very low, streams had dried up. Shallow dams which silted up during the winter were nothing more than "bog holes". Many farmers had no option but to sell stock, many were reduced to a bare minimum of hungry breeding ewes. All killable wether lambs and many lines of ewe lambs from breeding flocks went to the freezing works. Many light-weight lines of 23 and 24 lb passed over the hooks. Overall lamb weights were down 4 to 5 lb on previous years. Ewes were returning from 8s. to 10s. less than last year and there have been many instances of farmers losing £10 or more per head on breeding cows. Odd lines were sold for £5 to £8. A number of cows which were held in the drought area and then finally sent to the works as boners, were rejected because of their poor condition so that they realized only 16s. 6d., the price of the hide.

Although many farmers have sold off more stock than usual, their financial return has been much less. Thus, the full impact of this drought will not really be felt until next season. The winter carrying capacity on most farms in the worst affected areas is down; fewer ewes and cattle numbers much reduced.

How Farmers Handled This Season's Drought

There is no point in quoting cases where the farmer was badly caught and had to dispose of stock at low market prices — those were all too common — but two cases, from different classes of country will be of interest to readers.

First, a property some 15 miles south of Hastings — 470 acres, an average 28 in. rainfall, 80 acres flats, 200 acres rolling to hilly, and the remaining 190 acres steep hill country. The stock wintered last year was 2,400 breeding ewes, 400 ewe hoggets, a few wether hoggets, 70 breeding cows, and 20 dry cows. The property is well watered by springs and dams.

Over a period of years the flats have been tiled and mole-drained, and regularly topdressed, as is the procedure over the whole farm. Lambing commences in August and weaning takes place during November, depending on the feed position. Cull ewes — *i.e.*, aged and two-tooths — are fattened over the summer period and disposed of to a butcher. The calves are weaned at the end of April each year and the cull cows fattened and sold. In spite of the drought, no forced sales of stock were made this year because that farmer had the foresight to make provision for a dry year. That was done with grass silage. The owner had built up a reserve of 900 tons of silage for emergency, drought or facial eczema. He normally uses 300 tons but through this drought he used 600 tons. Cattle were fed silage from December until the autumn, the ewes were fed as conditions dictated. The silage was the self-feeding bun type so that the minimum of labour was required. Not only did this farmer have 300 tons of silage left after the drought, but he was able to purchase 1,100 cheap lambs in January — the majority selling later at a profit of 30s. per head.

As mentioned previously, the hardest hit farmer was the one on hill country with no arable land, the one with poor or inadequate water supplies. It was difficult to trace a farmer who was not forced to sell some capital stock, though some did "weather the storm" better than others, especially those who acted early.

One property of 800 acres, carrying 1,500 ewes, 700 ewe hoggets, 500 wether hoggets, 80 breeding cows, 36 1½-year heifers, 70 weaners and 25 1½-year steers, held capital stock. The two-tooth ewes, shorn in September, were culled and sold off with the wether hoggets and 1½-year steers in early October. The lambs weaned in early November, picked deeply in early December, and the cull five-year-old ewes were also disposed of. The calves usually weaned in March were weaned in January because the cows were losing condition and early weaning would allow them to put some on again before going into winter. Because of good water supplies, the remaining ewes, ewe lambs, breeding cows, heifers and weaners were rotated round the farm. Through the drought the cows were grazed ahead of the ewes, not only to build up condition, but to keep as much cover on the paddocks as long as possible. At no stage were the gates open; the rationing of fodder was all-important. Although it was not necessary to graze the breeding cows off the property, the farmer expressed the opinion that, if he were forced to, he would not wait until the cows were very low.

The above practices are those of two farmers on different classes of country. Quite a number were able to hold stock, after disposing of surplus, by feeding out hay where they had ample water supplies, and irrigation if near a permanent river or stream. One farmer on light soils on the Ruataniwha Plains held all his stock because he had in reserve 1,500 bales of hay and 150 tons of silage. He also has an irrigation plant worth £1,000 as an insurance against drought. This year he irrigated 16 acres of grass to fatten 250 lambs, also grazed 12 two-year-stud bulls and 50 early weaned calves. This early weaning of calves would not have been successful if the supply of good quality grass had not been available.

One interesting point made by farmers: not one said he would change his stocking methods because of this drought. Odd farmers stated that they would perhaps cut down slightly on their breeding cows. If farmers are going to continue with their present methods, then provision must be made for emergencies, otherwise they must be prepared to stand the consequences of a bad season when it comes.

Lessons Learnt from the Drought

The most important part of this paper is: What has been learnt from the drought?

WATER SUPPLIES

From the writer's observations and those of all farmers, plenty of good water is the first essential. A large number of farmers in the drought area were forced to sell stock because of the lack of this vital commodity. It is useless conserving hay or silage and growing supplementary crops if stock do not have adequate water.

During an average drought in Hawke's Bay, the daily needs for run cattle are approximately 20 gallons per day, for ewes 2 gallons, and for dry sheep about 1½ gallons. Some farmers maintain enough water should be stored for a 6- to 7-month period without rain. This may seem a long time, but had more farmers aimed at this amount the effects of the drought would not have been so widespread, and the loss on forced sales of stock could probably have been avoided.

Where properties are served with streams and permanent rivers, two things have to be taken into account — first, ensuring that the river or stream is permanent and, secondly, checking stock access to see that it is suitable. Natural springs are an excellent source of water, but they

should be properly tapped and fenced, otherwise they become graveyards, particularly for cattle, during prolonged dry spells.

Dams are by far the most common source of water throughout the district, but they must be properly sited. If at all possible, a large central dam holding at least 1,000,000 gallons of water should be built and well fenced. The water is pumped to a concrete reservoir and gravitated by piping to troughs. On some farms in Hawke's Bay this is being done. Fences should have at least three wires to keep cattle out, allowing only sheep access, but are best completely stockproof. Farmers estimated that, where dams were not fenced, at least 50 per cent. more water was used.

Most open dams become a menace in a drought. They are nothing more than "bog-holes" — stagnant scum-covered pools of stinking luke-warm water — more or less muddy reservoirs for all the stock droppings, and breeding places for stock diseases. How many farmers had to inspect their dams each day to remove bogged sheep? Farmers are unanimous that, where stock had plenty of good quality water, they held their condition much longer than those that had poor water. At least two or if not three good-sized dams are required for a 40- to 50-acre hill country paddock.

Farmers can get finance to build a combined flood detention and stock water dam and they can also get help in designing these from the Department of Agriculture, catchment boards or from Massey College. Stock water, good quality water, is of paramount importance in any area subjected to drought — it should be first and foremost in any financial outlay for improvement and development.

FEED SUPPLIES

The management and rationing of grass during a drought on a hill country property can be rather difficult; the earlier the drought, the worse it is.

One outstanding factor during this last drought was the marked difference between topdressed and untopdressed country. The native grass country was the first to show the effect of the dry weather; it produced no feed even after odd showers, whereas the sown and regularly topdressed pastures held on much longer and made some growth after rain.

When grazing during the drought, it is fairly obvious that paddocks that may become short of water should be grazed first. It is not advisable to open all the gates on the farm and give stock free range unless there is a serious water shortage. Grass can be rationed by "tightening up" the

flock ewes, which will encourage more growth and allow a picking over the remainder of the property for cows and calves and also cull lambs.

Tree Foliage

In past droughts, willow-tree foliage has saved the cattle on some properties. In this last drought one case is brought to mind where a well-known farmer on the coastal area retained all his cattle and ewes by feeding out a small quantity of threshed hay and poplar foliage. The property is subject to soil erosion and over a period of years has been extensively planted with poplars. In December, 600 cull ewes were sold; the remaining stock, some 4,000 sheep and 640 cattle, were held on the property throughout the drought period. Molasses was watered on to threshed hay prior to feeding out to cattle. Early in the New Year two men with a chainsaw were employed to cut poplar tops for sheep and cattle. Feeding continued throughout January when the sheep were taken off, tightened up, and rotationally grazed over the farm. Cattle continued to feed on the tree tops until early March. The farmer made no forced sales of stock and his usual yearly sales of surplus stock were made in the autumn. The trees then have served a two-fold purpose — erosion control and supplementary feed. Most important, the trees were not damaged; in fact, the topping will allow regrowth to provide poles for future plantings.

Special Purpose Pastures

Pastures containing *Phalaris tuberosa,* cocksfoot, lucerne, Montgomery red clover and white clover withstood the drought exceedingly well, provided they were not grazed too close. While it is not recommended that the whole farm be sown in a special mixture, it would be an advantage on all farms in a dry district to have at least two such areas. The deeper rooting species will seek moisture at a lower level than ryegrass-white clover and also seasonal growth is better spread.

Supplementary Crops

Choumoellier has proved over the years one of the best supplementary crops to grow. If sown early enough, it will withstand very dry conditions in the summer and autumn. With the spring drought last season, strikes of choumoellier were poor; by the New Year there was very little of some crops left, and it was obvious that these were not going to produce very much supplementary feed for a dry autumn. Some farmers accepted this as more bad luck but others

successfully overdrilled with turnips after a light rain. Millet has also been sown with success and will withstand dry conditions with a minimum amount of moisture.

Hay and Silage

In a district like Hawke's Bay more lucerne should be grown and farmers on arable land should give more consideration to this valuable crop, either as hay, silage or grazing.

All know the value of hay and silage for feeding to stock over an emergency period, and the necessity of having plenty of both in reserve cannot be overstated. This season, one farmer who made pit silage in 1932 dug it up in excellent condition and fed it to cows and calves.

On arable land, self-fed bun silage has its advantages as it is easily made and requires no labour in feeding out. "Buns" can be spread over several paddocks, which does not dictate any serious stock management. One disadvantage is that it does not keep as well as pit silage — losses can be as high as 40 per cent. — so care must be taken to make sufficient to carry over reserves until the following year. The farmer must always remember that the reserves are for a definite emergency period such as drought. He must not be tempted to reduce reserves just because markets are favourable in a good season.

STOCK MANAGEMENT

On the low rainfall areas, the fat-lamb farmer has a fairly flexible stock policy. He works to a programme of fattening his lambs as early as possible. As the season becomes drier, he disposes of his cull ewes early and either fattens his cull lambs or, if they cannot be fattened, he sells them. He runs no breeding cows but buys in dry cattle when he has feed available. The ewe flock numbers are not built up until the following autumn, therefore through the worst of the drought period he has only a minimum of ewes on the property.

However, in recent years, a number of farmers have switched over to breeding or to a semi-breeding policy. The coastal country, although not really in the low rainfall area, is predominantly breeding with some fattening and over this last season some farmers have adopted some interesting practices in an attempt to hold their breeding stock.

Sheep

Although lambing in the drought area commenced round the end of July or early August, weaning actually started in late October; the majority of farmers weaned in November

or early December. If it was at all possible to pick for fat lambs this was done. Early weaning has a definite advantage in a dry year — the ewes can be mobbed up, thus conserving feed for the lambs, and the ewes can be culled and disposed of. It is essential when early weaning (under hill country conditions) to return the lambs to the same paddock. They know where water and shade can be found, and if weaned into a strange paddock they will hang by the gate for days, thus losing condition.

When picking takes place, the farmer should go as deeply as possible into the line, taking anything that will hang up, and if desperate, kill the ewe lambs as well as wether lambs. After the cull lambs have settled down, the ewe lambs can be moved to a better paddock with good water and culled as required. If the remaining wether lambs cannot be held and fattened, they should be sold. The two-tooth ewes should also be culled in October and the culls sold.

To hold the flock ewes in the best condition they should not be mustered in the heat of the day or left in the yards or woolshed without water. Nothing will take fat off ewes quicker than to hold them in a confined space without water. It is amazing how they will hold condition if left alone in a paddock with virtually no feed, provided ample shade and good fresh water are available.

Cattle

If breeding cows are carried, calves can also be weaned early, in December or January. However, some farmers favour weaning the early born calves in December or January and holding the later calves on their mothers. The early weaning is advisable only if sufficient feed is available; if not, hay should be fed to the calves. A farmer by this time should be able to judge the feed position and dispose of the weaners if he cannot hold them. Cull cows, heifers, and any surplus dry stock (including sheep) will, of course, be sold before the feed surplus becomes too low.

DRAINAGE

As mentioned earlier, the wet winter had a marked effect on this season's drought and it was noticeable that the wettest country dried off fastest. Under-drainage improves both early spring and summer production as well as permitting full utilization of pasture during the wetter months. The reason is, of course, one is creating a greater depth of aerated soil, and improved species are able to fully develop

their root systems. The use of the mole plough alone or together with tiles is the key to better drainage on soils with impervious clay subsoils.

CATTLE GRAZING OUTSIDE THE DISTRICT

If it is necessary to obtain grazing outside the district, especially for cows and calves, it is essential that the offered grazing be inspected. Cows born and bred on good top-dressed country do not thrive on untopdressed native pasture or fern. This was a lesson learnt by a number of farmers this season: do not leave it to someone else to arrange — breeding cows and calves are expensive to replace. Unless good grazing can be procured it may be wiser to cut losses early, rather than have months of worry and expense, then eventually have to do it anyway.

Conclusion

A normal drought descends gradually and farmers should take action early before the stock really get on top of the pasture feed supplies and lose condition, and before markets become too depressed. Stock, especially cattle, should not be allowed to die on the property before a decision is made to dispose of the remainder. Adequate water is a must if any property is to be run efficiently. Stock disposal will make it possible to "empty out" with the minimum of inconvenience and loss, and/or, to adjust grazing programmes to best advantage, in a "freak drought" year.

Droughts have their problems, but they also have their uses in cleaning country and forcing farmers to cull unproductive or otherwise unsuitable stock.

DISCUSSION

Q : : *What has been done by the Government to help financially those farmers who lost money as the result of the drought?*

A : : Apart from the subsidies being paid on the cartage of hay "for immediate use", up to £5 per ton, and the reimbursement on return freight only on stock sent to outside grazing up to a maximum of 200 miles, the Government has arranged State guaranteed bank overdrafts for those farmers requiring finance for rehabilitation. These overdrafts are available through the Bank of New Zealand at the usual bank rate of interest.

In addition, Cabinet has approved and arrangements have been made with the Inland Revenue Department for taxation relief on the forced sales of stock. Where a farmer was forced to sell stock in one financial year and because of the drought unable to buy in again until his next financial year, he can apply for a taxation adjustment. In the application, which is normally done through an accountant, it is necessary to supply information on all sales of stock over the last 2 to 3 years.

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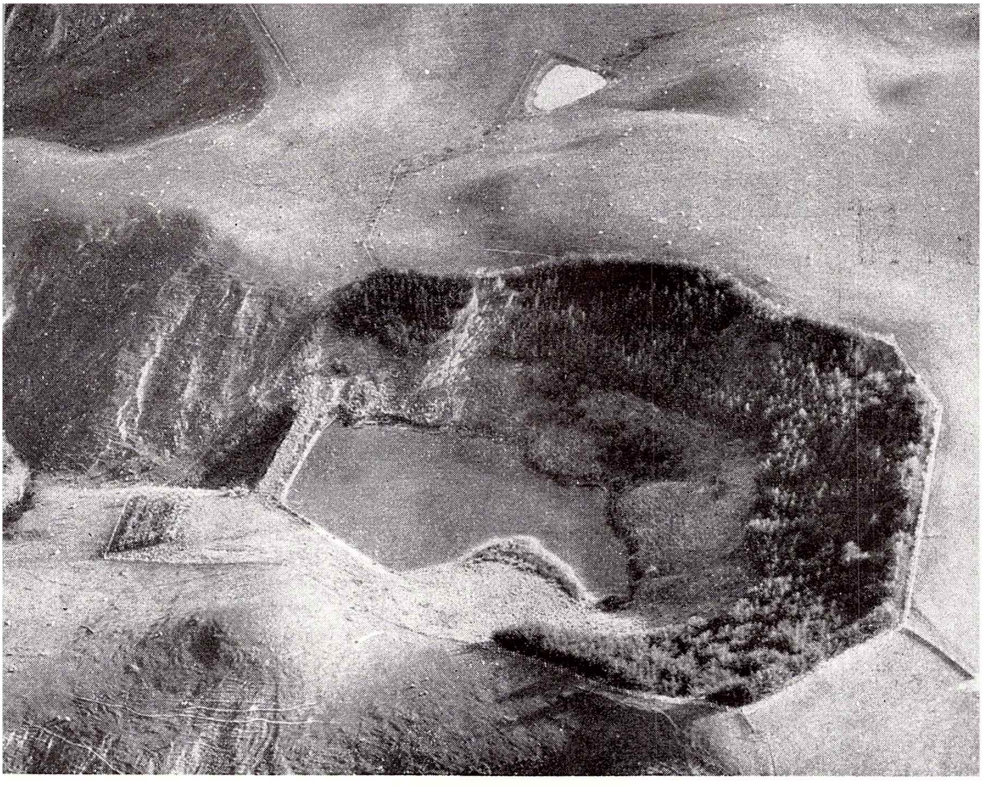

FARM DAMS

D. G. BOWLER*

FARM DAMS can be constructed for a variety of purposes — for example, stock water, fire prevention, domestic purposes and irrigation. Frequently they will be intended to serve a combination of these functions.

The purposes for which stored water is to be used will largely determine both the site and size of dam, and provide justification for the costs involved in construction.

For livestock, domestic use, or fire prevention, usually a few thousand gallons will be sufficient, but for irrigation the consideration is very different indeed. It takes more than one-quarter of a million gallons to irrigate one acre of pasture over a period of three months, which is a reasonable allowance in New Zealand for local drought conditions. Generally speaking, the water needed to grow the feed for a dairy cow is 150 times greater than her drinking requirements.

* *Drainage Advisory Service, Massey College, Palmerston North.*

If a dam is to be constructed for stock drinking purposes in a 50 acre paddock, the following example will be a reasonable guide to the capacity required:

Assume duration of dry period as 90 days; 3 ewes per acre and 15 cattle.

150 ewes at 2 gal per day	300 gal
15 cattle at 10 gal per day	150 gal
Therefore daily requirement ...	450 gal
For 90 days, requirement	40,500 gal

Allowing a margin of 50 per cent. for weather risk and losses by evaporation and seepage, not less than 60,000 gallons should be stored in the dam. Since there are 6¼ gallons of water per cubic foot, the dimensions of the dam must include 9,600 cubic feet below the water line. Very approximately, this could be found in a dam of 9 ft maximum depth and 210 ft around the perimeter of the waterline.

Accordingly, to contain this paper within the limits of the space available, some of the more important aspects of constructing dams not larger than 100,000 gal capacity will be discussed.

Just as the development of "turkey nest" dams on flat land have proved to be a cheap form of water storage in Australia for local irrigation, particularly for dairying, so too could certain types of water courses, which abound in New Zealand as natural features of the landscape, be utilized for storage in a series of dams constructed along them; provided of course, this arrangement in any individual case could be made to stand the test of economic feasibility.

A little more attention to detail would considerably improve water storage in dams on many farms in the North Island.

Selecting a Site

There are five points to consider in selecting a site to be filled by run-off from a natural catchment:

(1) Soil.
(2) Site and storage ratio.
(3) Catchment.
(4) Foundations.
(5) Spillway.

SOIL

The soil should contain sufficient clay to be distinctly plastic when dampened. A practical field test can be made by dampening a representative sample of the soil available for building the embankment, and moulding it by hand

into a cup shape. If this receptacle can retain water for, say, two days, the soil material should be satisfactory for dam making.

In those few districts where the soils are unsuitable because they are pumiceous, too sandy or too silty, attention is drawn to trial and research work being carried out in Australia, notably by the Water Research Foundation, using soil conditioners and plastic film, further reference to which is outside the scope of this paper.

Most farmers in the Wellington Province and Hawke's Bay are very favourably placed in respect of suitable soils for dam making.

SITE AND STORAGE RATIO

The site where the most water can be stored with the least amount of earth-moving is the one to look for. Such considerations as site elevation relevant to the paddocks to be watered by pipe-line and trough, ease of fencing, catchment planting, position in respect of cultivation, cropping, future opportunities for cleaning, direction of prevailing wind in some localities, all have a part to play in finally selecting suitable positions.

Provided the dam is not too shallow, evaporation losses are not normally serious in New Zealand, but a poor site is one where, other things being equal, the volume of water stored is approximately equal to the volume of earth excavation. The larger the dam the more important this consideration becomes.

A useful yardstick in judging dam sites is what is known as the "storage ratio". This is the ratio of the volume of water stored to the volume of earth moved to impound the water.

A preliminary survey of a site must include the setting of pegs around the proposed water-line and the determination of the level of the embankment. It is then possible to calculate roughly the amount of water stored *above* the existing ground surface by an embankment of selected height, using the following formula:

Volume of water in gallons = (⅓ maximum depth in feet) × (surface area in square feet)

In estimating bank height, at least 18 in. above the water should be allowed for freeboard and settlement.

To Calculate Volume of Bank

Volume of bank in cubic feet = (½ maximum cross-sectional area in square feet) × (length of bank in feet)

NOTE: Cross-section can be conveniently represented as comprising two triangles and one rectangle, the areas of which can be simply calculated, added together and used as indicated in the above formula.

If the bank material is taken from the upstream side as is usual, storage ratio is then:

$$\frac{\text{Volume of water} + \text{Volume of bank}}{\text{Volume of bank}} : 1$$

Both volumes must be in the same units — *i.e.*, cubic feet or gallons.

A rough estimate of cost will be obtained by allowing 2s. 6d. per cubic yard of excavation, although size of bulldozer, skill of operator, and transport expenses will influence the final cost.

The economics of farm dam construction is largely the effect of the storage ratio and, excepting special cases, it is desirable that a site with at least a 3 : 1 ratio should be looked for.

CATCHMENT

In the months of May, June and July, about 12 in. of rainfall occur over most of the Wellington Province. On a per acre basis, this is more than 270,000 gal and little difficulty should be experienced in filling a new dam constructed in the late summer, or replenishing those heavily drawn upon during the preceding summer. Meteorological records show that, of all the elements significantly distinguishing local climate, rainfall is the one least amenable to generalization. Distribution is unique in both time and space, but no district of New Zealand receives more than 35 per cent. or less than 15 per cent. of its annual total in any one season. This means, relative to water storage, that, provided the dam is well constructed in suitable clay soils, no difficulty should be experienced in filling it and the smallest of catchments, sometimes as little as one half acre, is sufficient.

Catchments should not include eroded areas and on steep yet cultivable land used for cropping the immediate environs of the dam should be left in grass to minimize the movement of silt.

FOUNDATION

A good holding soil contains 20 to 25 per cent. clay and the rest sand and silt. If the clay content is too high, the bank may creep or slump under the pressure of stored water. There is also the tendency to crack and leak.

Ridges of metal, ironstone or timber should be prospected for with a soil spear before construction com-

mences, as these are potent causes of leakage. In the case of metal it can usually be removed and the position backfilled and sealed with selected clay material.

A thorough profile sampling as a guide to the suitability of the soil is a necessary preliminary to excavation, particularly where soil texture changes are likely, as for example between yellow-brown and yellow-grey loams occurring in the Kimbolton, Waituna West districts.

SPILLWAYS

Where large catchments occur above small dams, inadequate spillways frequently cause washouts, particularly after the first year or two following construction. On some sites spillways can be costly. The ideal one has a low spur on one side of the embankment where floods can escape into the main channel.

A contour spillway is useful where a length of 20 to 30 ft can be constructed on a grade of 1 : 1,000. The water will flow over in a sheet and the spill area should be treated as a grassed runway. This type of spillway operates to advantage in conjunction with a pipe through the bank to take small flows.

Dam Building Design and Procedure

Under most conditions in New Zealand, farm dams are built in depressions or at some point in a seasonally dry watercourse. Desirably the soil should be dry during construction. Working damp soil may result in cloddiness and this is a potential source of at least temporary leakage.

Bank slopes should approximate 1 : 3 on the upstream side and 1 : 2 on the downstream side, on banks under 20 ft high. A steeper grade on the downstream side can produce cracks along the length of the crest, causing slumping. Where high clay percentage soils are involved, this downstream slope may require doubling.

The top width of the dam can be determined according to the formula:

$$W = 2 \sqrt{(H + 3)}$$

W = top width of dam in feet.
H = height of bank in feet.

A key trench cut 18 in. deep is very desirable in all earth dams to make a proper bond between the foundation and bank material.

A procedure that can be recommended is as follows:

(1) Clean the topsoil from both the excavation and key trench area and stock pile beyond the embankment.
(2) Cut the key trench.

(3) Build up the embankment and consolidate in layers not more than one foot deep. Lugged tractor tyres are satisfactory for this job of consolidation.
(4) Cover the completed bank with topsoil and sow in grass.

Some Recommendations

Fence off the dam.

It is not advisable to plant trees along the embankment, as root development may ultimately cause leakage.

Ideally the water should be fed into a trough away from the dam. This is best arranged by laying 1 in. diameter alkathene pipe through the bank at the time of construction, about 2 ft below the water-line. A suitably perforated fitting and float can be attached at the input end.

Siphoning water over the bank is possible, but air blocks can be most troublesome.

Make provision for emptying the dam for cleaning every five years. This is easy to arrange in summer by using a portable centrifugal pump and subsequently cleaning out with a bulldozer.

If a dam is persistently muddy, try spreading gypsum evenly over the surface, at the rate of 12 lb per 1,000 gal.

DISCUSSION

Q : : *Is it possible to construct dams in limestone country using bentonite to help seal them?*
A : : I would expect that the construction of a concrete wall, as an embankment core, with the foot of the wall set well into the limestone, would be a more likely solution. The soil should be built around it as for a normal earth embankment.

Q : : *Is polythene sufficiently durable for sealing dams since it needs to be exposed to sunlight?*
A : : Polythene is waxy and translucent and breaks down when exposed to sunlight, owing to the oxidative action of ultra-violet rays. The incorporation of carbon black, resulting in black polythene, provides a plastic film which can be used satisfactorily for outdoor use.

Q : : *Does a pipe-line in a dam as advocated by the speaker interfere unduly with the construction of the dam?*
A : : No. It is necessary to install the pipe-line before the bulldozing commences and at a level relating to the final depth of the dam. A careful survey of the site is an important preliminary and seep collars are quite essential in the pipe-line.

Q : : *Is silting a problem in dams situated at the bottom of steep gullies?*
A : : If the catchment is eroding this could be the case. In the long term the catchment should be improved by oversowing and topdressing. Tree planting may also be important according to the problem. If the need is for more urgent action, building a sod wall to form the front of a silting basis — say, 100 ft from the dam — is usually effective provided the immediate approach to the dam is in strong grass.

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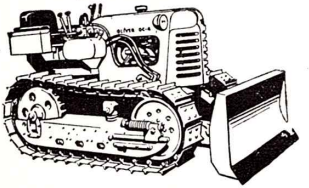

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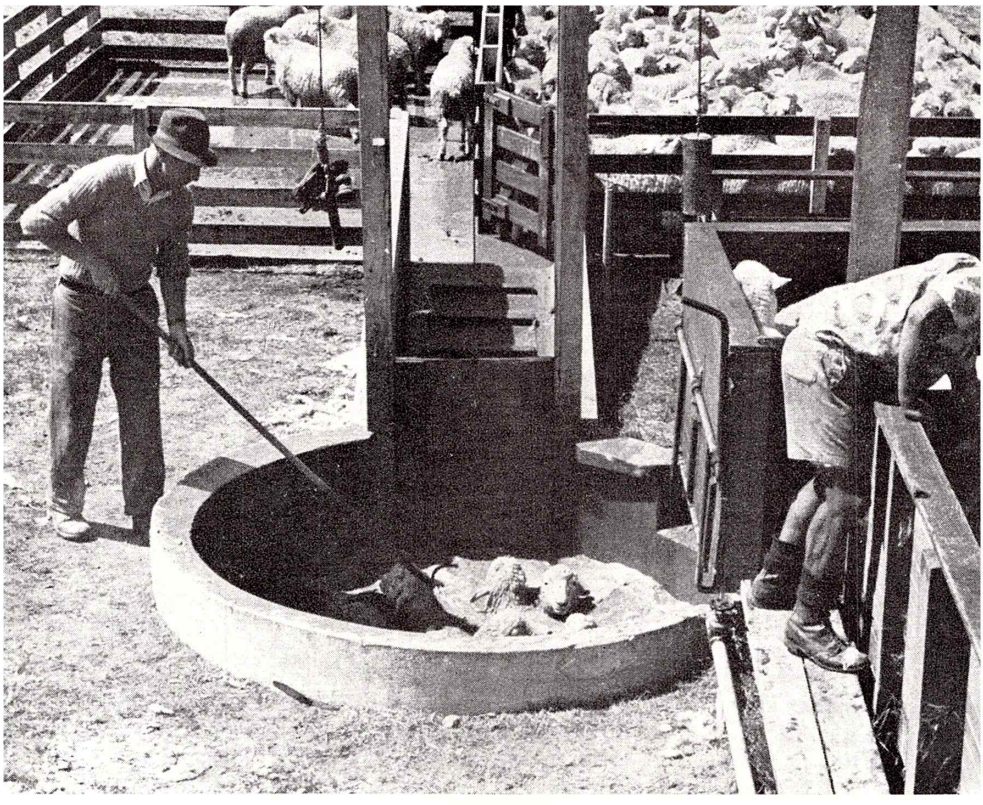


NEW SHEEP DIPS AND DRENCHES

L. K. WHITTEN*

DURING RECENT YEARS there have been very rapid changes taking place in the treatment of both external and internal parasites of livestock. Many commercial firms have directed a great deal of effort towards developing new insecticides and worm remedies, a number of which are now available in this country while others are still under trial and are not yet on the New Zealand market.

Phenothiazine, which has been used now for over twenty years, is at present being challenged by several different materials. Some of these are more effective, and with others it is possible to avoid some of the disadvantages of phenothiazine, such as wool staining.

* *Parasitologist, Wallaceville Animal Research Station, Department of Agriculture, Wellington.*

Experimental work at Wallaceville has been concerned with examining some of the new materials in an attempt to evaluate them under New Zealand conditions and to determine what is their margin of safety.

One of the first of the new drenches to appear was "Frantin", a drug with a wide safety margin. Its main value at the time of its introduction was its very high efficiency against *Nematodirus*, and it appeared soon after work in Britain showed that this parasite could be more important than was previously appreciated. The drug has an effect on other parasites but its cost was so high that it could only be recommended against *Nematodirus* in unweaned lambs and on properties where this worm was known to be important.

More recently several drenches belonging to the group of organophosphorous compounds were used. Neguvon was one of the first and although it has been used widely overseas it has not been used in New Zealand to nearly the same extent. It is probably of more value in cattle than in sheep, but it shows a rather unpredictable tendency to cause poisoning. Although Atropine can be used as an antidote, symptoms of poisoning may not appear for an hour or so after dosing.

Montrel is another organophosphorous compound which has a rather wider safety margin. It again appears to be more useful in cattle than in sheep. In New Zealand this material is available as an oily solution and a relatively small dose rate is used. In this field, Montrel has given only fair results and on a few occasions poisoning has occurred, especially when sheep have been yarded overnight before being treated. Montrel is active against *Haemonchus*, *Ostertagia* and *Trichostrongylus* but not against *Nematodirus*.

Several other organophosphorous compounds are being investigated at present.

More recently Promintic — a derivative of pyridine — has been introduced. It is unusual in that it is given by injection and kills the worms via the blood stream. It controls parasites of the small intestine, including *Nematodirus* and immature worms as well, but it tends to fail sometimes against parasites of the fourth stomach. Its disadvantages are its high cost and its fairly narrow safety margin. A similar preparation, called "Mintic", has been put up for dosing by mouth and its performance is similar to that of Promintic.

In the last year or so, a new drug called thiabendazole or MK360 has become available for experimental use. It is a white powder usually administered as a suspension in water. Trials have been done in New Zealand with it at Ruakura, Wallaceville, Lincoln College, and Taieri, and all workers have confirmed the overseas results indicating that it has a very wide safety margin, and a very high efficiency against most of the roundworms of sheep and cattle. This last season, field trials using this drug were run in many areas of New Zealand but the results are not yet available. Dose for dose, thiabendazole is slightly more expensive than phenothiazine, but, with its higher efficiency, less frequent dosing might easily make it a cheaper drug to use. It is not yet available commercially in this country but it is likely to be on sale in the near future.

Treatment of External Parasites

It should be realized that dipping as prescribed under the Stock Act is aimed at controlling body lice on sheep. The main object is to reduce the spread from infested flocks to the clean flocks of neighbours and to limit the spread of infestation by sheep sold through the saleyards. Arsenical dips are very effective against lice, but they have the disadvantages that they are not very effective against keds or blowflies and they sometimes cause scald if rams are dipped too close to the breeding season or if a shower of rain follows closely on dipping. Derris root added to arsenic kills keds and for many years this was a standard dipping material.

When synthetic insecticides became available, they were tested as sheep dips and benzene hexachloride (BHC) was the first to be widely used. More recently aldrin and dieldrin replaced BHC because they were more persistent and also because they diffused in the fleece and made possible surface application methods. The long persistence of dieldrin proved to be an embarrassment since it was absorbed into the fat depots of the body, and, because of its slow rate of excretion, it remained there for months.

Organophosphorous compounds have since come into wide use and they have the advantages of fairly high efficiency though they diffuse less readily than dieldrin. They are rapidly excreted from the body so that the residue problem is small except for a short period soon after dipping. Several organophosphorous compounds are available, the commonest ones being Diazinon, Asuntol, Nankor and Delnav.

It is important to appreciate that in controlling lice a complete muster is essential; dipped sheep are protected against reinfestation for a period after dipping but sooner or later this protection breaks down and one straggler can reinfest a flock. For the same reason, it is important that boundary fences should be sheep-proof and that all sheep bought in should be dipped before they are run with the rest of the flock.

Louse control is simpler if all sheep can be shorn together and dipped soon afterwards, but this practice is becoming more difficult with the greater tendency to spread shearing over several months.

In the case of surface application with the new organophosphorous compounds, treatment when the wool is short is essential. If shearing is too widely spread, surface application can be used only after the main shearing, and sheep carrying longer wool at this time should be plunge-dipped or showered to saturation.

It is often hoped that a single treatment soon after shearing should control lice and give a full season's protection against blowflies. No insecticide is able to do this at present. It is better to consider lice and fly-strike as separate problems, to treat routinely for lice at or soon after shearing, and to give preventive treatment for blowfly strike only if necessary and then at a time when strikes are to be expected. Shearing alone or crutching gives about six weeks' protection from fly-strike.

The full limit of the protection of an insecticide can be realized if it is used when the first strikes appear. In the same way, concentration on the susceptible areas, such as the crutch, by jetting techniques is better than spraying the whole body. In the case of body strike, which tends to be rare and less predictable than crutch strike, it could be treated if and when it makes its appearance and here again back jetting is the technique of choice. Fly control now depends almost entirely on the action of the organophosphorous compounds, since flies in New Zealand were becoming increasingly resistant to dieldrin. Several strains which have been tested at Wallaceville required about 400 times the usual dose to kill them. This obviously would have ruled out dieldrin entirely for fly control. Fortunately, all strains tested so far have been fully susceptible to the organophosphorous compounds.

The cost of treatment with the new insecticides is high, especially if high concentrations are needed for prolonged fly protection. It should be remembered, however, that

doubling the concentration does not give double the length of protection but only a relatively small increase in the protection time. Some economies can be made in treatments for fly protection. A careful assessment of the problem on a particular farm should be made since there are many farms where the problem does not exist or is so small that treatment is not warranted. If the incidence is low, the disease may cost less than preventive treatment. Since the crutch strike is mainly a disease of ewe lambs, treatment of wether lambs and older ewes in which strike incidence is very much lower may be omitted, and in this way a second treatment of the susceptible animals could be used if this proved to be necessary.

DISCUSSION

Q : : *Is diazinon effective in the control of leg lice?*

A : : I have no information on leg lice but I would think that diazinon would be effective at least with saturation methods.

Q : : *How efficient is the drench called "Kempak" and can it be mixed with calciferol?*

A : : Kempak contains Montrel. It is similar to phenothiazine in efficiency. It controls *Haemonchus, Ostertagia,* and *Cooperia* but not *Nematodirus.* It would be wise not to mix it with calciferol but to give the two drenches separately.

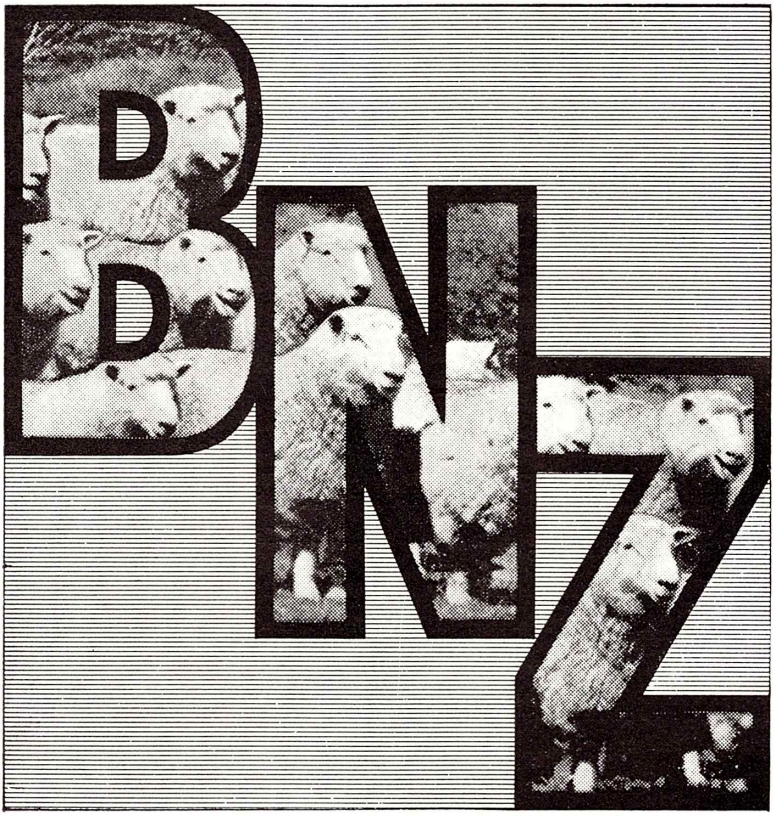
Q : : *Will lice on goats provide a means whereby sheep can be infested with lice and do keds spread from goats to sheep?*

A : : Lice from goats are quite distinct from those on sheep and neither will establish on the wrong animal.

Keds do occur on goats and even cattle but not commonly.

Q : : *Is is possible to achieve 100 per cent. control of parasites using one of the organophosphorous compounds to dip pregnant ewes carrying, say, seven months' growth of wool?*

A : : Saturation methods should give complete control in these circumstances but it is doubtful if surface methods would do so.



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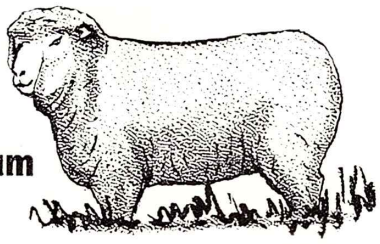

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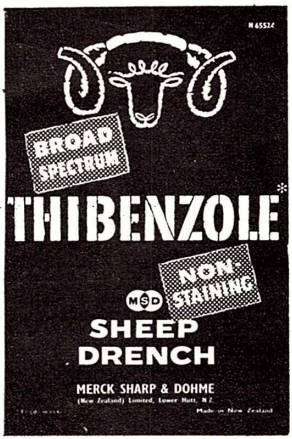

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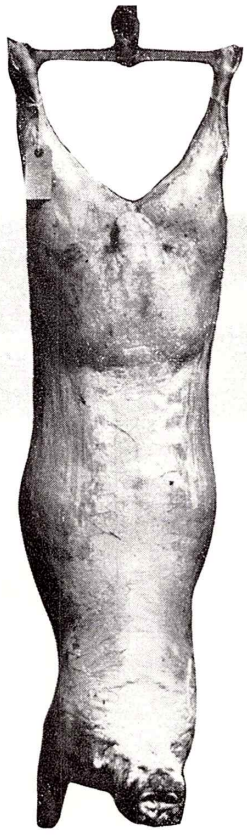

INSECTICIDE RESIDUES AND OUR EXPORTS

R. C. STUART*

THIS PAPER is an attempt to review recent developments in the field of insecticide residues in relation to agricultural exports, and will deal with the following aspects: Prospects for joint international action; some recent research and field experiences; and the Agricultural Chemicals Board.

Prospects for Joint International Action

There has been an increasing world-wide awareness and concern on the part of food and health officials, and of the farming industry itself, about the presence in foodstuffs of pesticide residues. This question of residues, as is well known, has been the cause of concern to the Government for some time.

Pesticides are indispensable to the farmer in his fight against pests and diseases and, in many countries, the very pattern of agriculture has been changed by the introduction and wide adoption of chemicals. Without their use, many foodstuffs could not be produced, at least economically, and the yield of all foodstuffs could be seriously reduced.

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The Food and Agriculture Organisation of the United Nations (FAO) considers that about one-third of the present world food production would be lost if agricultural chemicals were not available. Present production in the U.S.A. of potatoes, apples, citrus fruits and cotton would be reduced by 50 per cent. and meat, milk and wool by at least 25 per cent.

It is generally accepted by most countries that food should be pure, but it is also recognized that, because of the necessity to use pesticides, residues may occur.

It is the responsibility of the authorities marketing farm produce in New Zealand to ensure that the requirements of any overseas Government or buyer are met. Experience over the past few years demonstrates the trend in many countries towards progressively stricter standards. In some countries, these take the form of bacteriological standards, in others chemical and compositional. New Zealand has not yet failed to meet any of these standards, but special measures have been introduced to make that possible.

However, what worries and concerns New Zealand (and can be most vital in ensuring the free flow of international trade in agricultural produce) is the variation in residue requirements by importing countries. The maximum permissible residue is fixed by law in some European countries — *e.g.*, in Canada and in the U.S.A. — while in Switzerland and Britain control is effected by advice to the user instead of regulation.

It is interesting to note the three considerations that must apply in the U.S.A. when tolerances are being established. Briefly they are:

(1) A safe residue for humans is considered 1/100th of the least amount found to produce symptoms of chronic toxicity in experiments conducted on laboratory animals. Thus, if 100 parts per million of a diet was the maximum that could be fed to dogs without effect, then the foodstuff residue could not exceed 1 part per million.

(2) The residue must be in conformity with the use of the chemical in "good agricultural practice".

(3) No substance that is carcinogenic (cancer producing) may be added to foods.

In order to protect the public, the U.S. Food and Drug Administration (F.D.A.) in 1961 had a budget of approximately £6 million for enforcement, and occupying a conspicuous place in its programme was insecticide residues in food, particularly DDT and like materials.

Incidentally, it must not be thought that the American authorities have singled New Zealand out for attention. Certainly some U.S. interests might be perturbed about the imports of sheep meats, beef and Colby cheese but this in no way influences the F.D.A. It is just as severe on locally manufactured goods from animal products and, because it has the responsibility for public health, it is one body above possibly all others in administration which is free from political influence.

The variation in residue requirements by importing countries was recognized as a major trade problem at the 11th Conference of FAO in Rome in 1961, and reflects the world-wide concern on the subject. The Conference passed a resolution calling on the Director-General of FAO to establish a Committee on Pesticides in Agriculture. This committee will assist in planning and organizing a conference between member governments this year to discuss the health, commercial, legal and technical problems involved in the control of pesticides and to formulate an acceptable World Code for control.

New Zealand strongly supported this move and is hopeful that it will promote the safe, efficient and informed use of pesticides and facilitate international trade in foodstuffs.

The prospect of international joint action is certain to exert an enormous stabilizing effect but it should not engender a false sense of security and cause relaxation into an attitude of complacency. International agreement will take time; insects do not stand still and new insecticides will continue to appear and create new problems.

Some Recent Research and Field Experiences

During the past year or so, the Department of Agriculture in co-operation with the Stock Remedies Board and the Agricultural Chemicals Board has, by regulation and through its advisory services, placed greater emphasis on the safer use of pesticides.

It was obvious that the two chief reasons for contamination in New Zealand were that:

(1) In the treatment of New Zealand's large animal population against external parasites, the use of chlorinated hydrocarbons in the form of dieldrin and aldrin was widespread. Dip formulations containing these ingredients, although highly efficient, could result in residues in the fat of treated sheep — and such residues could persist for considerable periods.

(2) In order to control grass-grub and grass caterpillar damage to pastures and crops, farmers used 110,000 tons of DDT-superphosphate in 1960–61.

It is not intended to discuss any aspects of sheep dips, but the relationship between the technique in the application of DDT and actual pasture contamination may be of interest. An understanding of this relationship will enable farmers to see more clearly the reasons why they must scrupulously continue to comply with the regulations concerning the withholding-from-grazing period for stock.

The problem of insecticide residues in farm produce can be reduced to the following three facts:

(1) It is known that, when pasture contaminated with insecticide is grazed by stock, the insecticide will accumulate in their body fat and will appear as a residue in milk or meat.

(2) No residue of any insecticide is permitted in milk or any dairy product — *i.e.*, the tolerance for insecticides in dairy produce is nil. For meat there is a very small tolerance.

(3) Stock must therefore be kept off insecticide-treated areas until the forage is safe from the residue point of view.

It is clear, therefore, that the key to the problem for any particular insecticide is the length of this withholding period. To help to decide what this time should be it is necessary to know what happens to an insecticide when it is applied to pasture. DDT-superphosphate dust is used as a typical example.

Suppose this insecticide/fertilizer mixture is applied to short pasture at the usual rate of 2 lb of DDT in 2 cwt of superphosphate to the acre. The initial deposit is easily visible as a whitish powder covering the whole pasture and it is fairly obvious that the residue of DDT on the grass at this stage will be extremely high. During the next few days, most of this initial deposit falls from the grass on to the soil surface, being dislodged mechanically through movement of the grass by the wind and the sluicing action of rain. DDT, however, is insoluble in water, but dissolves readily in oils and waxes. Whenever particles of fertilizer dust lodge on the waxy layers of the leaf surfaces, the DDT dissolves or diffuses into the wax and becomes virtually a part of the plant itself. This absorption of DDT probably begins to take place as soon as the topdressing is applied and no amount of rain will remove this waxy layer of DDT. In fact, the chemist who must remove this DDT from the

grass for analysis cannot do the job by extracting with water but must resort to fairly drastic measures. It is not surprising, therefore, that rainfall has so little effect on this part of the DDT residue. After the first week or so, the DDT, firmly attached to the plant, may be reduced to some extent by evaporation, by chemical breakdown through the action of sunlight, and by other factors, but there is good evidence to show that the major factor causing a reduction in the DDT level after this time is dilution of the residue by plant growth. For instance, a residue of 10 parts per million will be reduced to 5 parts per million when the bulk of grass per acre is doubled. It takes time for grass to grow and a "time for growth" factor or withholding period must be observed before it is safe to put stock back on to DDT-treated pasture.

The next question is: When are topdressed pastures safe for stock — safe, that is, from the viewpoint of no residues in the animal products? A trial completed recently at the Stratford Demonstration Farm showed that cows could be safely returned to DDT-treated areas when the level of DDT on the pasture had fallen to about 1½ parts per million (on the dry matter basis). In plain language, 1½ parts per million of DDT on a good 3 in. long pasture is equivalent to 1 gram or 1 teaspoonful of DDT per acre. On the day pastures are topdressed the farmer is actually applying 2 lb of DDT, which is 908 grams or 908 teaspoonsful of DDT per acre. If the pasture is to be safe for dairy cows immediately after topdressing, it is obvious that only 1 teaspoonful of the 908 applied must stick on the pasture. This means that 907 of the 908 or 99.9 per cent. of the DDT must fall straight to the soil without sticking to the grass. This, as can be imagined, is a practical impossibility with the present formulations of DDT or of any other insecticide.

Compare the following results with the figure of 1½ parts per million. At Wallaceville, on short dry pasture one day after treatment, a DDT emulsion spray left a residue of 2,440 parts per million; DDT-superphosphate dust (wet mix) left a residue of 490 parts per million. The dust was initially five times safer than the spray but still nowhere near the safe level. At Stratford, a week after topdressing, DDT-superphosphate left a residue of 57 parts per million, and DDT prills (pellets) a residue of 10 parts per million. The prills were nearly six times better than DDT-superphosphate but, even in this case, cows could not be returned to the prill-treated area until the safe level of 1½ parts per million was reached some four weeks after application. It is quite clear, however, that the concept and development

of the prill form of insecticide has been a major step forward in the treatment of pastures for insect pests, and a revision of the withholding periods for DDT prill-treated areas has been made for sheep and cattle other than dairy cows in milk.

The foregoing discussion has been limited to DDT. Not all insecticides are as stable as DDT in practice — for example, with some of the organic phosphates withholding periods of only a few days are required. The reasons behind these withholding times, however, are the same for most insecticides and the periods currently recommended are based on the best information available at present for the use of these chemicals under New Zealand conditions.

Another question which may be asked is: How long will DDT remain in the body fat? In trials carried out at Wallaceville, it was found that, if cows are withheld for only two weeks from pasture treated with DDT-superphosphate, it would be necessary to reject the milk from these animals for longer than six weeks before the milk could legally be sold to a dairy factory. And what has been found regarding dairy cows can be generally applied to meat-producing animals. Thus, as DDT is used only once in three years, compliance with the regulations is a worthwhile insurance for approximately 150 weeks of residue-free grazing.

Recent investigations on farms as a follow-up measure to the Department's fairly intensive produce-testing service, make it obvious that far too much reliance is being put on rainfall in the belief that one inch makes pastures safe for grazing.

Again, bull-beef has frequently contained DDT residue, sometimes to quite a high proportion. Use of bull-paddock pastures that have been topdressed with DDT preparations must be restricted in the same way as recommended for sheep and beef cattle. Thus bulls must not graze on them for at least four weeks after they have been top-dressed — unless prills or pelletted preparations are used, in which case the withholding period for sheep and cattle other than dairy cows in milk is two weeks.

Thus, if sheep farmers carry out DDT topdressing after the pasture has been grazed hard down, if the operation is performed in dry conditions, and if stock are kept off (irrespective of rainfall) until regrowth of pasture has sufficiently diluted any small contamination inevitable even on hard grazed pasture, then the use of DDT entails no risk of the occurrence of residues in milk or the body fat of grazing animals.

Brief mention should be made of three other pests which frequently steal the headlines from the grass-grub and the grass caterpillar. They are the black beetle, the cricket and the armyworm.

Dieldrin-superphosphate is the only material to date found effective against the black beetle, but cannot be used without a permit. Experiments are under way to check on the effectiveness of dieldrin prills in reducing residue risks. If these trials are satisfactory, the Agricultural Chemicals Board may then consider reducing the withholding period of 90 days.

Dieldrin was also effective for controlling the cricket, but now malathion and lindane baits have proved equally as effective. Commercial interests are going into the question of manufacturing prill baits of lindane and they should be available next season. To make the prill attractive to the pest, a substance such as molasses will be either incorporated in or coated on the prill.

Dipterex appears to be both effective and safe for the control of armyworm on pastures and fodder crops.

Malathion and dipterex may be applied without a permit provided certain conditions are observed, but a permit must be obtained from the local farm advisory officer before lindane may be used.

The efficacy of the control measures designed to ensure the correct use of chemicals on pastures and crops depends very largely on the co-operation of farmers. The Department's produce-testing service reveals that this co-operation is forthcoming. But there are some farmers who have misunderstood, or prefer to ignore, the advice and recommendations. Fortunately, their numbers are small, but it must be remembered that even one case of a deliberate or accidental misuse of a residue-producing chemical could lead to a serious marketing incident. Furthermore, farmers must realize that the problem is not a short-term one but calls for continual observance of recommended practices.

The Agricultural Chemicals Board

The Agricultural Chemicals Act provides legislative power to require the safe use of insecticides. The activities of the Agricultural Chemicals Board set up under this Act in 1959 are not as widely known as they should be. This Board, on which Federated Farmers is represented, was charged with the task of ensuring that agricultural chemicals used in farming are registered, are efficient, and are used safely. In

addition, the Board is responsible for promoting research and experiments on testing and improving agricultural chemicals and for the dissemination of information on their safe and efficient use.

The Board's activities are thus diverse and are intimately associated with many important aspects of seasonal farming operations.

For instance, it administers the regulations controlling the composition, colour, labelling, packaging and despatch of herbicide 2,4-D mixtures, encourages research into the effects of pesticides on wild life and in developing safeguards against residues in food crops.

The Board has practically completed the work of registering herbicides, fungicides and insecticides now being used in New Zealand; this includes approval of their labelled instructions and precautionary statements. This latter function is very much more important than is generally recognized throughout the farming industry. In fact, the Board is firmly of the opinion that most errors in the use of pesticides are due to failure of users to read directions printed on the labels.

An important way in which users of agricultural chemicals can help overcome this difficulty is to follow implicitly the manufacturer's instructions for use. No agricultural produce has ever been seized because of chemical residues when pesticides have been applied according to directions on the registered label. These directions are also the guide for applying the chemicals effectively and with safety to the user.

With the completion of registration and approval of container labels, the Board will engage in a campaign to induce all users to "Read the Label". The label is actually a brief summary of the results of research on the basic chemical which has cost (in the U.S.A. at any rate) millions of dollars over a two- to five-year period of development. These labels are said to be the most expensive literature on the market today. The implementation of these instructions, together with adherence to the regulations relevant to the use of DDT, could overcome residue problems — but it needs the full co-operation, understanding and goodwill of every farmer if the all-important confidence of importers is to be maintained.

Finally, New Zealand is inclined to associate residue problems with the U.S.A. — certainly it was the first country to establish requirements for insecticides. Remember,

however, that there is a trend in other countries, particularly in Europe, to follow the American lead and, if trade with such countries is desired, exports must comply with residue standards. As a guide, it would appear that, if New Zealand produce meets the exacting requirements of the North American market for meat and dairy produce, then it will fulfil the requirements of any other market.

Acknowledgements

Thanks are due to H. A. Foy and to D. L. Harrison who made available unpublished results of work on D.D.T.

DISCUSSION

Q : : *Under drought conditions pasture growth ceases, so how can DDT applied to the pasture be diluted through the growth of grass? Does the plant absorb DDT when it is not growing?*

A : : Whether the plant is growing or not, there is a certain amount of absorption. However, under drought conditions there will not be the same dilution but there is considerable loss through weathering during the withholding period. The diminution is not so marked by weathering as when the plant is growing under normal spring and autumn conditions.

Q : : *Is it safe to mix DDT prills with superphosphate and apply the insecticide this way?*

A : : This depends very largely on the nature and extent of handling as there can be considerable loss of DDT from the prill core through chipping and grinding. It the recommended precautions are taken to minimize abrasive action, then DDT prills mixed with superphosphates are only slightly less effective than prills alone.

Q : : *Are the fatty substances on the leaves of grass which absorb DDT the same for all species of grasses, clovers and forage crops?*

A : : This is not known, but the Department will probably carry out a series of trials along these lines in the coming season.

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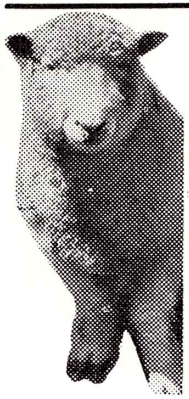

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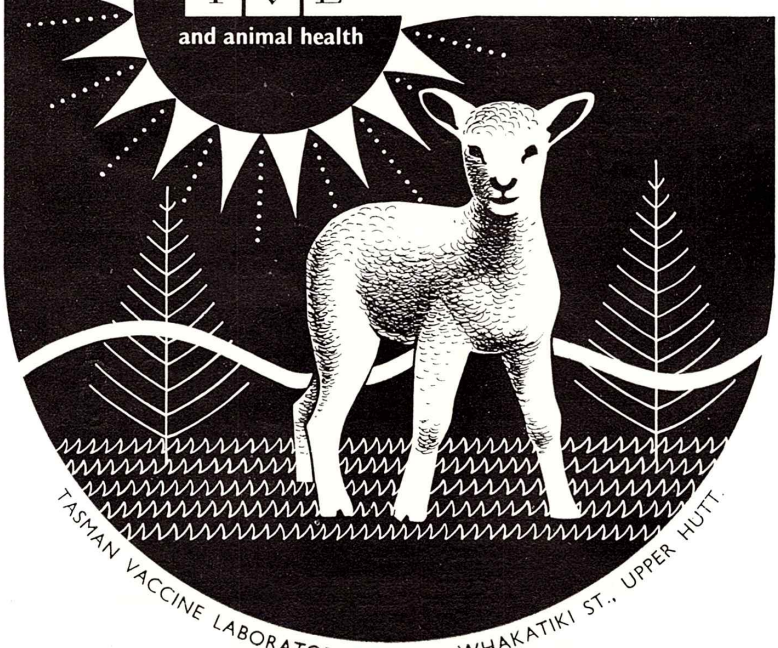

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General view of stocking rate trial area. In foreground are the heavy stocking with sheep plus cattle paddocks. The paddocks in the far background are lightly stocked with sheep without cattle.

RECENT TRIALS AT THE TE AWA HILL PASTURE RESEARCH STATION

F. E. T. SUCKLING*

IN 1959, a five-year extension of the lease of the Te Awa research area was arranged and new trials were planned and put into operation. These trials have now been running for a period of three years, and, although much of the first year's results cannot be included in this review, because the stock were subjected to the various treatments for only a limited period before lambing, etc., it is possible to give an interim report of the trends that have started to show up.

The trials are divided into three main sections:

Section A is a comparison of pasture and animal behaviour on heavily- and lightly-topdressed pasture.

Section B is designed to study the effects of very heavy stock carrying on heavily-topdressed hill country.

Section C is a graded stocking rate trial on heavily-topdressed country with and without cattle grazing with the sheep.

* *Grasslands Division, Department of Scientific and Industrial Research, Private Bag, Palmerston North.*

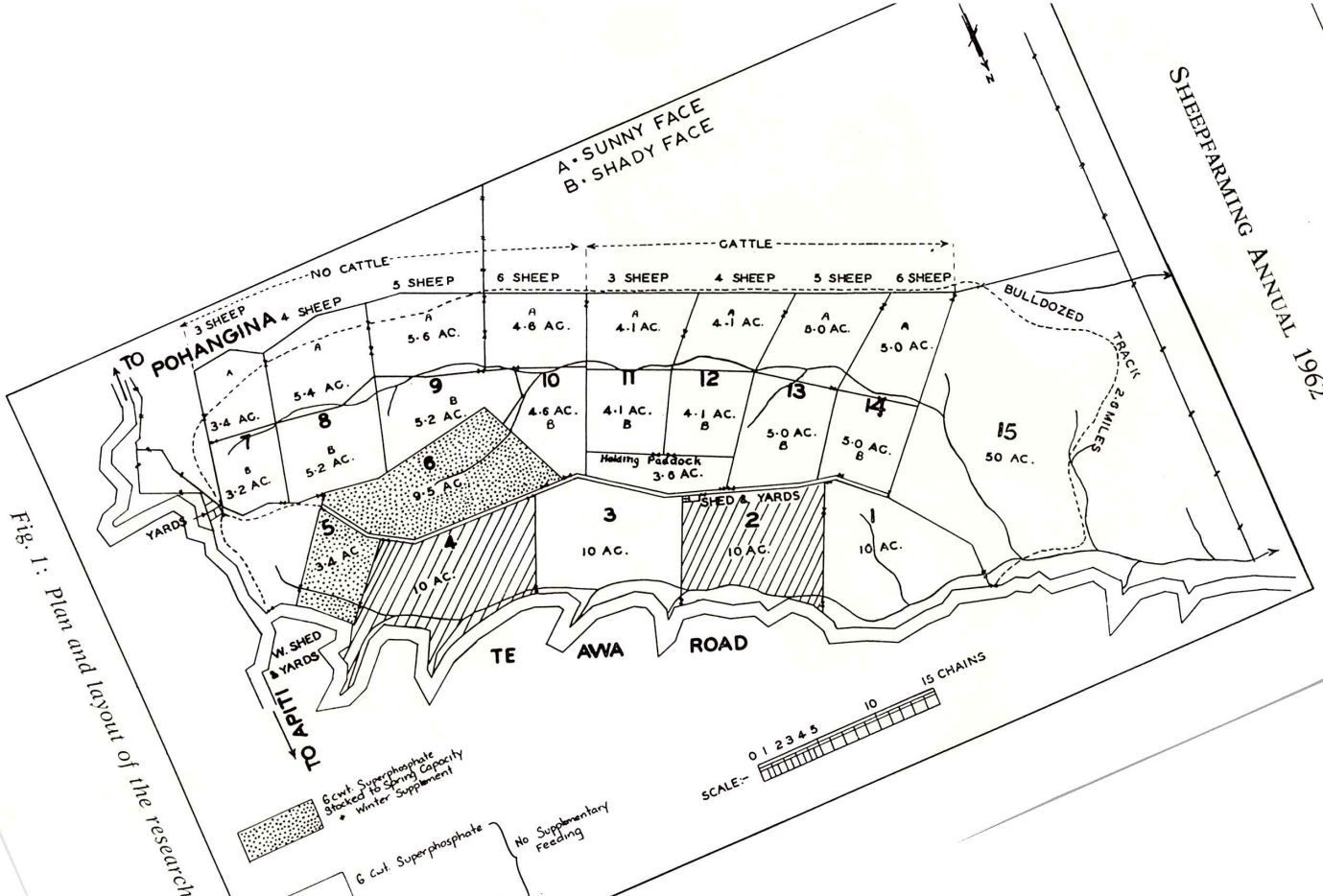


Fig. 1: Plan and layout of the research

Section A

For the purpose of comparing the effects of fertilizer rates on pasture and animals, four ten-acre paddocks on a sunny face are being used. Two paddocks have received heavy rates of fertilizer and two the normal 2 cwt dressings annually. Prior to the commencement of the trial in 1959, three of these paddocks had received two hundredweight dressings of superphosphate each year for a period of 10 years and had been oversown with clover seed once in 1949. The fourth paddock was a control paddock throughout the ten-year period and reached a carrying capacity of three ewes per acre, largely through the influence of subdivision allowing for full utilization of the feed produced. The improved pastures, on the other hand, had reached a peak of 5½ ewes per acre over the same period and were greatly superior in pasture composition and production. In 1959, the previous control paddock was oversown and topdressed with two dressings of 6 cwt superphosphate, in two consecutive years. This was then followed by two 2 cwt dressings in 1961 and 1962. Similar heavy applications of 6 cwt were applied on the other heavily-topdressed paddock and also followed by two 2 cwt dressings in 1961 and 1962.

Stock carrying has remained at 5½ ewes per acre on the two lightly-topdressed paddocks over the three-year period, but the area which had a previous history of annual 2 cwt dressings has risen from 5½ to 7 ewes per acre and the previous control paddock, now heavily topdressed, rose spectacularly from 3 to 6 ewes in three years.

It was apparent from fertilizer trials over a period of several years at Te Awa, that phosphate was the main factor limiting production, and the present trials demonstrate that spectacular results can be achieved by heavy application of fertilizer at the commencement of an improvement programme, provided one is prepared to stock up to that improvement.

Comparisons in pasture production have been made between the heavily- and lightly-topdressed areas, by the frame enclosure method and the contribution of the various component species in the pasture assessed for the years 1960 to 1962.

Table 1 shows the comparative total annual dry matter production for stock camps and hillsides for the heavily- and lightly-topdressed paddocks in pounds per acre.

TABLE 1: Annual dry matter production (lb per acre)

	Stock Camps	*Hillside*
Heavy topdressing:		
1960–61	18,815	12,398
1961–62	13,432	8,177
Light topdressing:		
1960–61	19,004	11,455
1961–62	14,411	7,122

Data in Table 1 show that there has been a noticeable increase in total dry matter production on the hillsides of the heavily-topdressed paddocks. The stock camp areas, which are a very small proportion of the paddocks concerned, on the other hand, show a slight reduction where heavy topdressing has been applied. This may be accounted for by the fact that the stock camps on the heavily-topdressed areas are under heavier stock grazing, with the resultant baring of the sward owing to excess animal fertility being voided on these areas. It is interesting to note that the 1961–62 season was a poor one owing to a wet winter and a dry spring and summer period. The two seasons under comparison show a variation of some 30 per cent. in dry matter production as the direct influence of an adverse season.

In summarizing species contribution to the total dry matter, it is apparent that the ryegrass content on the hillsides is greater in the heavily-topdressed paddocks — 10,962 lb in 1960–61 and 7,379 lb in 1961–62 — as compared with the lightly-topdressed paddocks — 5,900 lb in 1960–61 and 3,688 lb in 1961–62.

Clovers produced more in a growthy year on the heavily-topdressed hillsides but, in a dry season, the figures were much the same for both treatments.

LIVEWEIGHTS OF SHEEP

During the period under review, an endeavour has been made to maintain average liveweights of the sheep in the various paddocks as near uniform as possible, so that pasture production increases due to fertilizer treatment can be shown by increased carrying capacity while retaining relative uniformity in liveweight of ewes.

The heavily-topdressed areas showed increases in liveweight in the flocks grazing on them in the first two years, so that adjustments were effected by increasing stock numbers to bring liveweight averages down to the same level as the flocks grazing on the lightly-topdressed areas. Cattle grazing has been regulated according to the amount of surplus roughage available during the summer and autumn months.

LAMB LIVEWEIGHT AND LAMBING PERCENTAGE

Lambs from the various paddocks under light- and heavy-topdressing treatments were weighed 2 to 3 weeks after birth and again at weaning, and their daily gain in liveweight for the groups calculated. All the ewes on the research area are of the same age for greater ease in making comparisons, hence, in 1959, the ewes were 4-years' old, in 1960 5-years' old, and in 1961 a new flock of two-tooth ewes was grazed on the trial areas. It is generally recognized that older ewes are better mothers than two-tooths, hence variations in lamb daily liveweight gain rates and lambing percentages were encountered each year and particularly in 1961 with the young ewes.

Daily gain in lamb liveweight averages for the three-year period showed that, in the heavily-topdressed paddocks, although generally more heavily stocked, the lambs gained 0.39 lb daily against 0.37 lb on the lightly-topdressed areas. Lambing percentages for the three-year period were 97 for the two heavily-topdressed paddocks and 93 for the lightly-topdressed paddocks. The figures have fluctuated from year to year and with ewe age, from 110 per cent. at 5-years' old to 84 per cent. as two-tooths for the different groups. It will be necessary to continue for a longer period to be sure of a definite trend with lambing percentages.

WOOL WEIGHTS

All fleeces from the ewes on the different treatments were weighed and group averages calculated for each shearing. Unfortunately, it was not possible to obtain lamb wool weights for the years 1959 and 1960 because the lambs were weaned before shearing and removed from the research area; however, figures are available for 1961.

The three-year average wool weight for the heavily-topdressed paddocks was 28.4 lb per ewe compared with 27.7 lb for the groups on the lightly-topdressed paddocks. Lamb's wool for 1961 shearing averaged 2.3 lb from lambs on the heavily-topdressed areas against 2.0 lb on the lightly-topdressed paddocks.

It is apparent that both ewe and lamb wool weights are slightly heavier on the heavy fertilizer treatment in spite of heavier stocking rates. On the other hand, wool production per acre has, of course, increased greatly on the heavily-stocked, heavily-topdressed paddocks.

In summarizing results to date on the fertilizer rate trials, it can be said that generally a greater pasture production has resulted from increased rates of fertilizer application.

Ryegrass and clover have increased in the sward; liveweights of the sheep have been maintained at a reasonably comparable level, while increases in stocking rate have been made on the heavily-topdressed areas. Lamb daily liveweight gain, lambing percentage and wool weights have all been better when heavy rates of fertilizer have been applied, in spite of a relatively heavy carrying capacity.

Section B

This section of the trials at Te Awa is designed to study the effects of heavy stocking on heavily-topdressed hill pasture. Two dressings of 6 cwt of superphosphate were applied in 1959 and 1960 on pasture which had previously been topdressed annually at 2 cwt per acre for a ten-year period. Two paddocks are involved in the trial; this is, in effect, an attempt at stocking to spring carrying capacity, rather than winter capacity. To overcome possible pasture deficiency during mid-winter when grass growth almost ceases, the ewes receive an additional ration of sheep nuts or hay. No cattle are grazed on the two paddocks involved and the sheep are set stocked throughout the year.

In the first year, six ewes per acre were grazed with relatively good general thrift, while in the second year 6½ ewes were grazed. This figure was maintained during the third year because great difficulty has been experienced in feeding supplementary feed to the ewes in winter. Although starved in the woolshed for a period, the ewes refused to eat sheep nuts and similarly rejected hay. Consequently, little benefit has been derived by the ewes from supplementary feed. It has been suggested that the sheep are too well fed and that grazing pressure must be increased to force the ewes to seek supplementary feed. This year, stocking rates have been increased to 7 ewes per acre and attempts at training sheep on to a supplementary diet have so far been a little more successful, partly due to an exceptionally dry year as well as to the additional stock.

One of the two paddocks on which this group of sheep graze is a small sunny face paddock of about 3½ acres, and the other is an 8-acre paddock which is made up of part sunny face and part shady face.

PASTURE MEASUREMENT

In order to study pasture behaviour under heavy stocking with sheep, frame measurements have been made on a sunny face, on a shady face, and on the stock camp areas within the one paddock. Changes in pasture composition are being observed, and measured by herbage dissections

from samples from the frames cut over a five-year period. Measurements have been made for two years and it is apparent that seasonal variations are great between each year. On all three sites, there was a 30 per cent. reduction in total production of dry matter in 1961–62, compared with the year 1960–61. In a normal year with adequate summer rainfall, the sunny faces produce considerably more than the shady faces. However, in a dry year, the shady face produces almost as much as the sunny face and more during the summer period.

From general observations over the three years, it is apparent that the pasture is responding to heavy topdressing, and is becoming more dominant in ryegrass and clover content. The effect of heavy sheep grazing and consequently full utilization of all the feed growth is apparent. Throughout the year, there is no roughage or cattle feed left in the paddocks, but coarse weeds such as toetoe (*Arundo conspicua*), sedges and rushes have increased markedly in the gully bottom.

ANIMAL PRODUCTION

Liveweights of the ewes have been taken throughout the year and comparisons made between the heavily-stocked groups and the lightly-stocked groups of sheep on the area. Briefly, it is apparent from data obtained that increased stocking has reduced liveweight in the groups of sheep under this treatment. Daily gain in liveweight of lambs has declined and lambing percentage has been reduced. While, at six ewes per acre, the groups of sheep under very heavy stocking treatment were comparable with those grazed at 5½ per acre, the additional ½ ewe per acre has resulted in greater competition for food between ewes, and, when lambs are at foot, between ewes and their lambs. This result has been accentuated because of a dry year reducing total dry matter production to two-thirds of normal.

Section C

STOCKING RATE TRIAL

In this section of the trials, comparisons are being made on heavily-topdressed country (*i.e.*, two annual dressings at 6 cwt of superphosphate after 12 annual dressings at 2 cwt per acre) between graded rates of sheep stocking, with and without cattle. In the first block, there are eight paddocks, each approximately 5 acres in area, four being on a sunny face and four on a shady face. Each group of sheep is grazed on a pair of paddocks, one a sunny and the other a shady face, and the stocking rates are 3, 4, 5 and 6 ewes per acre.

On this series, no cattle are grazed for the duration of the trial. On the second block of eight paddocks, grouped in the same manner as the first, and with the same sheep stocking rates, cattle are grazed with the sheep to maintain pasture in what is considered to be a suitable short condition for sheep grazing.

In general, management for both blocks is set stocking with sheep, and, on the block which has cattle in addition to sheep, cattle are moved according to the availability of cattle feed. Cattle grazing days are recorded for all treatments. As can be expected, the lightly-stocked sheep paddocks require considerably more cattle grazing than the heavily-stocked paddocks. During mating, it is necessary to mob-stock each group between the sunny and shady face paddocks in order to reduce the number of rams for each experimental group. Rams are changed between groups, but as soon as they are finally removed the various groups of sheep are again set stocked on their respective paddocks.

Because the shady faces are colder and darker during winter and therefore with less pasture growth at this time of year than the sunny faces, it is necessary to reduce slightly the stocking rate on the heavier-stocked groups on this aspect, and to increase stock numbers on the sunny faces. Another advantage of having two paddocks for each treatment is the flexibility one has in sorting early- and late-lambers just prior to lambing. The early-lambers are set stocked on the sunny face and the late-lambers on the shady face. This also cuts down to a minimum the distance travelled in shepherding the ewes at the start of the lambing season. As spring growth commences, stocking rates within each group are balanced according to the amount of feed.

The upper limits for both groups of sheep (*i.e.*, those with and those without cattle) are dependent on the ability of the pasture to winter stock satisfactorily, and, should pastures improve or deteriorate appreciably under the management system imposed, then sheep numbers will be increased or decreased. Since the trials commenced, there have been increases made so that the heaviest stocking rate now stands at 6½ ewes per acre.

PASTURE BEHAVIOUR UNDER DIFFERENT STOCKING RATES

At the commencement of the trials in 1959, the whole area was mob stocked with a large mob of sheep for a period of several months while alterations were being made to the existing fences in preparation for the new programme. This mob stocking was necessary to endeavour to make each

paddock as uniform as possible before any stocking-rate treatment was superimposed on it; hence, when the areas were stocked with their appropriate sheep numbers, the pasture was uniformly short throughout.

After the first spring, under the various stocking rates, it was apparent, in the block where no cattle were grazed, that a dense mat of unpalatable, rank herbage had accumulated on the low-stocking rate paddocks. Interspersed between these rank clumps were closely grazed patches, so that, at the lowest stocking rate (3 sheep per acre), only approximately one-third to one-fifth of the total area was being grazed. The closely-grazed patches increased with increased stocking rates until, at 6 ewes per acre, almost the whole area was closely grazed and fully utilized throughout the year, with only a few tufts of roughage on the steeper banks. From a casual observation, it would appear that there is a larger difference in pasture utilization between the 4- and 5-ewe-per-acre treatments than there is between the 5- and 6-ewe treatments. The two heavier stocking rates maintain pastures in a relatively clean state throughout the year, while the 3- and 4-ewe treatments are continually rough with patch grazing a regular feature.

Within these long clumps of uneaten roughage on the lower stocking-rate paddocks, clovers have already disappeared. In fact, even after the first summer with light stocking, clover became smothered, no doubt owing to heavy fertilizer applications encouraging growth, and a failure to utilize this additional growth by adequate grazing control.

On the other hand, the block which has cattle to control surplus grass growth has been maintained over the three-year period in a fairly uniform state. It has been necessary to carry a high proportion of cattle on the 3-ewe-per-acre treatment and a diminishing proportion as sheep numbers increase. Thus, there has been little necessity for cattle grazing where 6 ewes per acre are carried, except for a short period during the summer months.

In these paddocks, clover content appears to be increasing and pastures are generally tending toward an increase in ryegrass, except for the low sheep-stocking and heavy-cattle treatment, where there appears to be a tendency for a mat of Yorkshire fog to develop.

In summarizing pasture observations on pastures grazed by sheep alone against those grazed by sheep and cattle, it can be said of the non-cattle paddocks that, for all stocking rates, coarse weeds have become most noticeable by their

presence. In the low-sheep-stocked paddocks, and particularly on the shady face, hard fern or carpet fern is starting to reappear. Similarly, in the gully bottoms *Carex* species or sedges are thriving unmolested, and toetoe spreading and growing rapidly. Rushes have also increased when no cattle are grazed. Nevertheless, apart from this weed problem, heavy stocking with sheep alone has encouraged good pastures.

When cattle are grazed, particularly at heavy rates, these weed problems are not apparent. Toetoe bushes are grazed by cattle and so are the sedges and other weeds mentioned above. On the heavier-sheep-stocking paddocks, when cattle are grazed, some difficulty is experienced in controlling coarse weeds because the ewes on these areas are continuously grazed (for experimental purposes) for a period of years at much higher than normally accepted rates, and the cattle grazed with them watched constantly to see that the pasture does not become pugged to the detriment of the sheep. A most noticeable feature of cattle grazing is that cattle will eat only good sheep feed until this has been cleaned up and only then will they condescend to clean up roughage. Another disadvantage of heavy cattle grazing with sheep has been noted at lambing time, when a relatively large number of lambs have been found bogged in seepage areas that have been severely pugged by the cattle.

PASTURE MEASUREMENT

There are many difficulties associated with the measurement of pasture production on hill country, the chief of which is the extreme variability of hill pastures and the necessity for large numbers of frame enclosures to achieve a reasonably representative sample of the herbage. There are additional major problems where pastures are patch grazed and in a matted condition, as are those in the stocking-rate trials, hence alternative methods of measurement have been devised to record changes in pasture composition, and to assess the quantity of unconsumed herbage in each treatment.

For this purpose, three transects each of one chain in length have been pegged in each of the sunny face paddocks. Along these transects, at one foot intervals, pasture heights are recorded and point analyses of the herbage cover made four times each year in spring, summer, autumn and winter.

Table 2 shows the annual pasture height in inches for the various treatments and the total amount of herbage remaining unconsumed in each for the year 1961.

TABLE 2: Annual pasture height (inches) and amount of unconsumed herbage — 1961

Treatment (ewes/acre)	*Pasture Height (in.)*	*Dry Matter/Acre Unconsumed (lb)*	*Dead Material (%)*	*Clover (lb./acre)*
3 ewes	4.5	2,484	48	9
4 ewes	1.9	1,220	43	24
5 ewes	0.9	719	29	14
6 ewes	0.8	583	28	16
3 ewes + cattle	1.0	776	32	29
4 ewes + cattle	0.9	601	33	25
5 ewes + cattle	0.8	505	23	18
6 ewes + cattle	1.0	537	30	18

To assess the amount of roughage or unconsumed grass in each paddock, 30 sq. ft quadrats were cut by hand shears on three lines across each paddock. The herbage from each transect was bulked, herbage dissections done to determine species contributions, and dry matter determinations made.

Table 2 shows that the quantity of dead grass or roughage follows in inverse proportion to stocking rate. Botanical composition data show that the least amount of clover is present where light stocking with sheep is carried out without cattle, but where cattle are grazed with 3 or 4 sheep per acre, heaviest quantities of clover are recorded. An interesting point shown in the extra low figure for dry material in the 5 ewes + cattle was the difficulty of actual use of cattle on these small areas. Although there was a small amount of cattle feed on this treatment, the cattle grazing was a little more severe at times than desired.

LIVEWEIGHTS OF SHEEP

Ewes from all treatments have been weighed several times each year and from the data it is possible to give an assessment of the relative average liveweights of the ewes for the three-year period.

TABLE 3: Average liveweights of ewes for three-year period

Treatment (ewes/acre)	*Average Liveweight (lb)*
3 ewes	122.2
4 ewes	122.5
5 ewes	119.3
6 ewes	115.6
3 ewes + cattle	126.1
4 ewes + cattle	126.8
5 ewes + cattle	121.8
6 ewes + cattle	112.3

The figures in Table 3 show that there has been a gradual decline in liveweight of ewes as stocking rates have

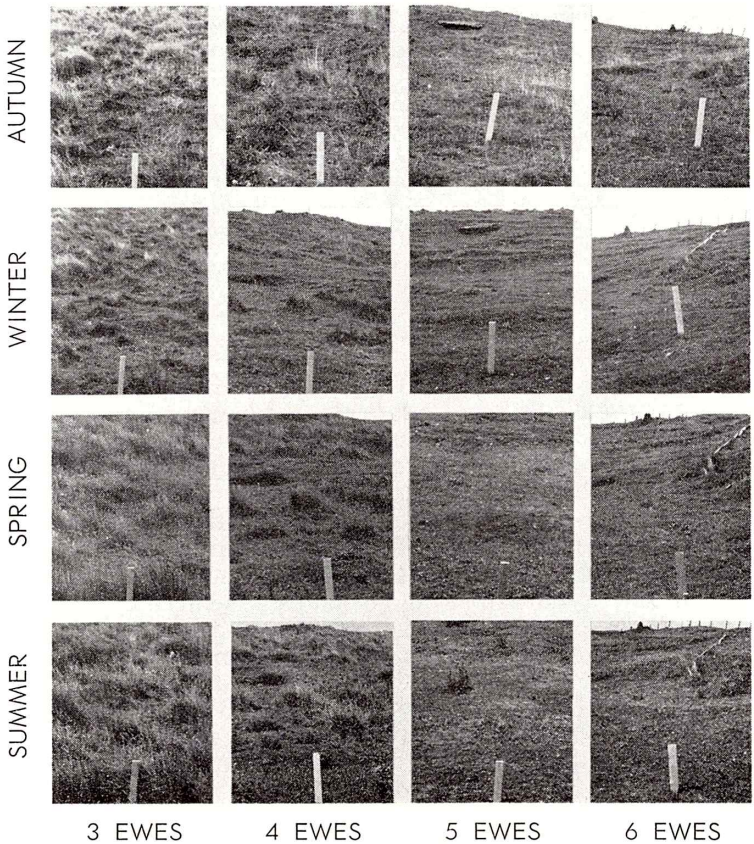


Fig. 2: Permanent pegged transects photographed seasonally for each stocking rate. This series shows paddocks which have been grazed by sheep alone.

increased. However, where no cattle are grazed, the difference between the 3-ewe-per-acre treatment and the 6-ewe treatment is only 6½ lb per ewe, whereas where cattle are grazed the difference is more than double this figure (13.8 lb per ewe). It is interesting to note that the heaviest ewes were those stocked at 4 per acre with cattle; similarly, those at 5 per acre were heavier than where no cattle were grazed to control surplus roughage.

LAMB LIVEWEIGHTS

Liveweights of lambs were taken for each group and the daily gain in liveweight calculated. Lambing percentages

were recorded also and are shown in Table 4 as averages for the years 1959 to 1961.

TABLE 4: Average daily gain in liveweight of lambs and lambing percentages for the period 1959–1961

Treatment (ewes/acre)	*Average Daily gain in Lamb Liveweight, 1959–61 average (lb)*	*Average lambing % for period 1959–61*
3 ewes per acre	0.40	115
4 ewes per acre	0.36	101
5 ewes per acre	0.41	96
6 ewes per acre	0.36	98
3 ewes + cattle	0.49	108
4 ewes + cattle	0.45	115
5 ewes + cattle	0.38	101
6 ewes + cattle	0.37	103

The results in Table 4 show only small differences between daily gain in liveweight of the lamb where no cattle were grazed, but, where cattle have been grazed in association with the sheep at the two lower stocking rates, much better lamb growth rates were obtained. It would appear that cattle are successfully suppressing rapid spring growth and maintaining the pasture in better condition for lamb growth.

Lambing percentage figures are assessed on the number of ewes put to the ram and lambs weaned. Individual groups of sheep have shown wide variations each year and according to ewe age; however, the three-year average shows a higher percentage for the lightly-stocked groups, 3 per acre with no cattle and 4 per acre with cattle. As mentioned previously, the area carrying 3 ewes plus heavy stocking with cattle suffered lamb losses through lambs being bogged in seepage areas badly pugged by cattle. The lowest lambing percentage has been from paddocks carrying sheep at heavy rates of stocking and no cattle.

WOOL WEIGHTS

During the three years under review, wool weights have been recorded from individual ewes and group averages taken at each shearing.

Table 5 shows wool weight averages for the three years 1959 to 1962.

TABLE 5: Wool weights for the period 1959–1962

Treatment (ewes/acre)	*Total Wool Weight per ewe (3 seasons) (lb)*	*3 yr. Total Wool Wt. per acre (lb)*	*Av. Lamb Wool Wt. (lb)*
3 ewes	30.4	91.2	2.1
4 ewes	29.5	118.0	2.6
5 ewes	29.5	147.5	2.1
6 ewes	27.5	165.0	1.9
3 ewes + cattle	32.1	96.3	2.2
4 ewes + cattle	31.3	125.2	2.7
5 ewes + cattle	31.1	155.5	2.1
6 ewes + cattle	28.0	168.0	1.6

The figures in Table 5 represent actual fleece wool produced over three years and 26 days, with three age-groups of sheep (*i.e.*, 4-year-olds, 5-year-olds, and two-tooths).

Lamb's wool was recorded for one year only from lambs off two-tooth ewes. Unfortunately, the lambs were weaned and disposed of before shearing in 1959 and 1960, hence no figures are available.

It is apparent that wool weight decreases as stocking rate is increased, both in the groups without cattle and in those where cattle are grazed with sheep. The data show also that wool weights are heaviest in the low-sheep-carrying, plus cattle, area. Lamb wool weights show that the best individual lamb wool growth has been obtained from areas which have been stocked with ewes at 4 per acre either with or without cattle, although there is a slight improvement in weight where cattle were grazed. The lowest lamb wool weights have been from the area grazed at 6 ewes per acre plus cattle.

It may be argued that lower stocking rates are preferable because of the increased wool production per ewe; however, it cannot be denied that heavy stocking rates greatly exceed light stocking rates in terms of wool weight per acre. For the three-year period, 6 ewes per acre produced approximately 200 lb of wool per acre, lamb's wool included, against approximately 115 lb per acre for the three-ewe per acre group.

50-acre Paddock

One hundred and thirty acres of the total area of 180 acres are subdivided into 5 and 10 acre paddocks, but there is a further 50 acres, in one paddock and comprising all aspects, which is being used as an example of a normal farm-sized area on which best management practices can be carried out. Heavy topdressing has been applied at

similar rates to those on the stocking rate trial, except that fewer 2 cwt dressings were applied in past years. Stock numbers have been increased so that there are 5 ewes per acre being carried. In the second year, it was apparent that the area was not adequately stocked so 30 head of hoggets has been run in addition to the mature ewes on the paddock for the last two years.

The ewes have to date followed closely the trends in body weight and wool weights of those in the stocking-rate trial. Lambing percentages have been high and lamb thrift good. It is obvious from the results from this area that high stocking is the all-important factor governing full and efficient utilization of all the fodder produced, rather than paddock size.

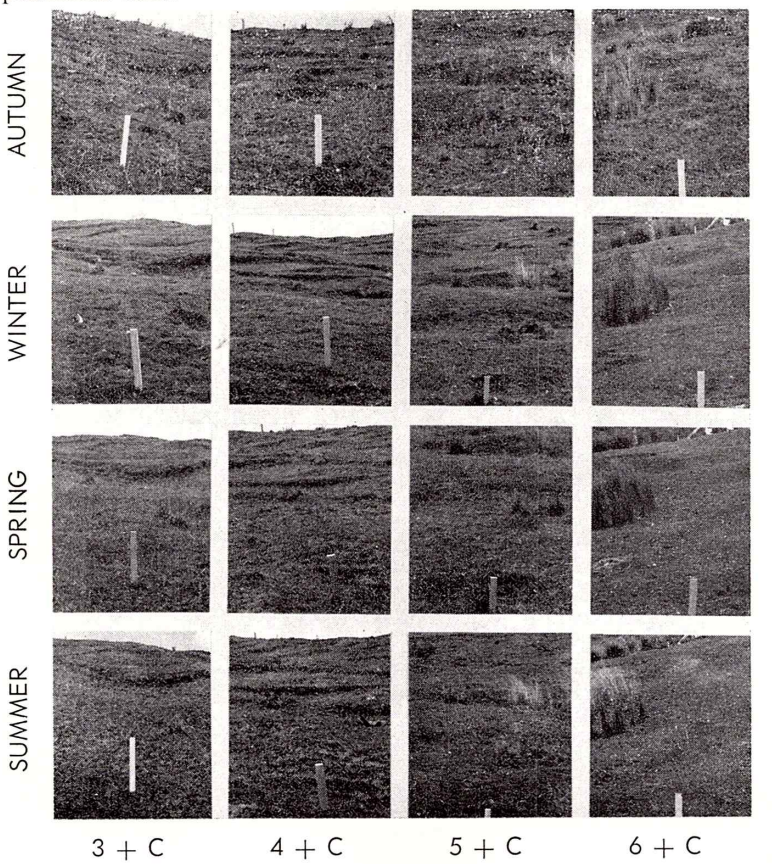


Fig. 3: Permanent pegged transects photographed seasonally for each stocking rate. This series shows paddocks grazed by sheep and cattle.

Conclusion

In conclusion, as a result of observing closely the current trials during the three-year period, the main impression of the key points to improvement of this class of country are subdivision into sunny and shady faces, topdressing and clover establishment — all these with adequate extra stock. Low stocking rates (at Te Awa the low rates are twice as high as carrying capacity on farms in the district) result in poor utilization of pasture, with consequent patch grazing and suppression of clovers. Even though the pastures may be cleaned up by mid-winter by large mobs of cattle, the clovers are weakened under rank summer growth which then remains in the pastures for several months.

At the Te Awa area on 180 acres of what may be classed as steep hill country, there are already (even with the low-carrying treatments) 930 ewes plus 15 head of dry cattle and 30 hoggets being grazed, and this is far from the full potential. On the average hill farm, difficulties arise in obtaining sufficient animals to stock up to any improvement from oversowing and topdressing. Unless this is done, however, any such improvement is lost through inefficient pasture management.

DISCUSSION

Q : : *Have the ewes on the heavily-stocked area experienced more sleepy sickness than the others?*
A : : No. So far, in the three years the trial has been going, we have had no sleepy sickness either in the lightly or heavily stocked areas. This is probably due to the declining plane of nutrition through late autumn and winter with no sudden changes or fluctuations in diet.

Q : : *When does lambing occur and when are the lambs weaned? What happens to the lambs after weaning at Te Awa?*
A : : Lambing usually commences about the middle of August and the lambs are weaned at the end of December. After weaning, the ram lambs are taken to "Kamano" at Cheltenham to be selected and culled for future flock rams, and the live lambs are shifted to a property at Waiata.

Q : : *What is the pH of the soil at Te Awa?*
A : : The pH level is about 5.2 to 5.6.

Q : : *Are the ewes managed in any special way before mating in order to increase their lambing percentage?*
A : : No. The ewes are all permanently set stocked in this trial. The only flushing they get is the natural flush occurring about this time with the onset of autumn rain.

Q : : *Would chemical ploughing at Te Awa achieve greater success than the pasture improvement methods employed so far?*
A : : We have not tried chemical ploughing at Te Awa. However, I think that we would have had as much difficulty in establishing and maintaining surface sown ryegrass, using this method, as we did using our normal methods because of the low fertility of the soil

in its original state. As far as the clovers are concerned, we have had no difficulty in establishing them by the normal methods which do not involve the additional expenditure of approximately £7 per acre to achieve simulated drought conditions.

Q : : *Has the speaker examined the economics of the heavy rates of topdressing used in relation to the meat and wool produced per acre at Te Awa?*
A : : We have not, in fact, been studying the economics of topdressing in this series of trials at Te Awa. We have been trying to assess pasture responses and animal thrift under the different fertilizer treatments.

Q : : *Are there any differences between the flocks for wear of their teeth under different stocking rates?*
A : : We are following the wear in sheeps' teeth with the present flock which came on to the area last year as two-tooths. They will be held on the area until 5 years old and over this period records will be kept and the results made known at a later date. You may recall that Dr Barnicoat found some difference in teeth between sheep which were set stocked and rotationally grazed on unimproved pasture, at Te Awa. Those which were rotationally grazed had better teeth at 5 years of age than the set stocked sheep. At the same time, he found that sheep which were set stocked on unimproved pasture had poorer teeth than those set stocked on improved pasture.

Q : : *What month of the year was the fertilizer applied and would results be different if it were applied in the spring or in the autumn?*
A : : Fertilizer is usually applied in February or March. The main object in applying phosphate is to feed the clovers and encourage the nitrogen exchange to the grasses, hence the date of application should coincide with the maximum growth periods of the clovers, which is in spring and autumn. Ideally, one should apply two dressings annually.

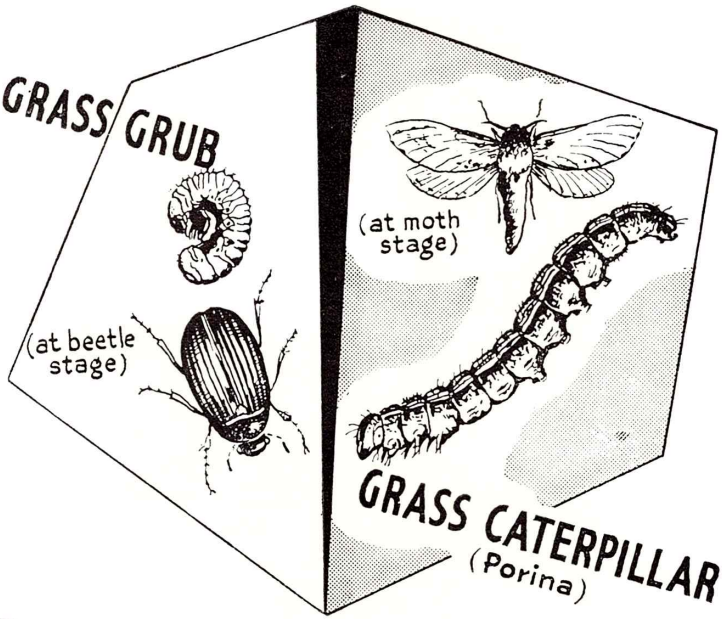
Q : : *What is the incidence of grass grub in the research area?*
A : : Grass grub has been a serious problem in the past. We have carried out experiments to determine the reduction in pasture production due to grass grub and subterranean caterpillar, and have found that, on areas not treated with DDT, pasture production has been 20 per cent. lower than where control measures have been taken. The whole area has now been topdressed with DDT-superphosphate.

Q : : *Would soil erosion increase in the heavily-stocked areas?*
A : : We have no evidence to suggest that the heavily stocked areas are more subject to erosion than the lightly stocked areas. Last August, every paddock on the area had about two slips, regardless of stocking rate.

Q : : *Is the Te Awa soil deficient in molybdenum? If it is not, does this explain why clovers do so well there?*
A : : The Te Awa soils are not deficient in molybdenum. I would suggest that the clovers have done well because we have done our best to sponsor them with appropriate management and topdressing, fully appreciating their importance in grassland farming.

Q : : *Were any precautions taken to prevent the ewes developing facial eczema?*
A : : No precautions were taken against facial eczema as all groups of sheep are set stocked in this experiment. What eczema we had, in one season, was all on short-grazed sunny face pasture.

Control Pasture Pests!



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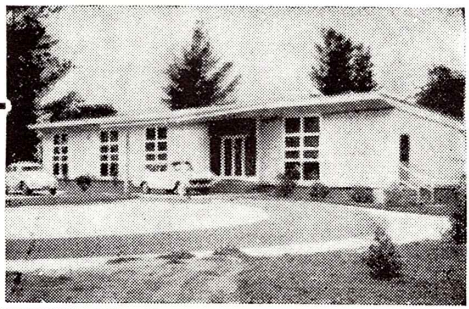
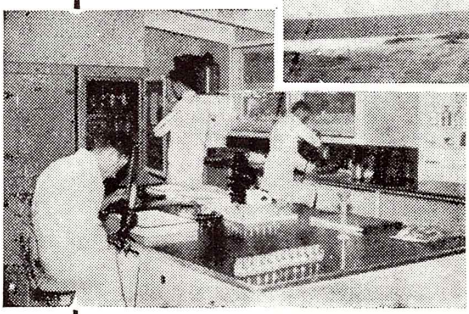
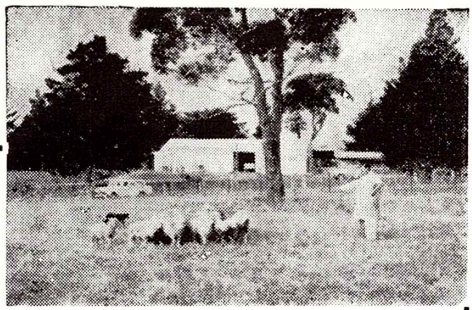




Scenes of Parke, Davis & Co.'s Veterinary Experimental Station at Mittagong, N.S.W.



RESEARCH

Parke, Davis & Company in 1959 established a new Veterinary Experimental Station on 200 acres of land at Mittagong, N.S.W.

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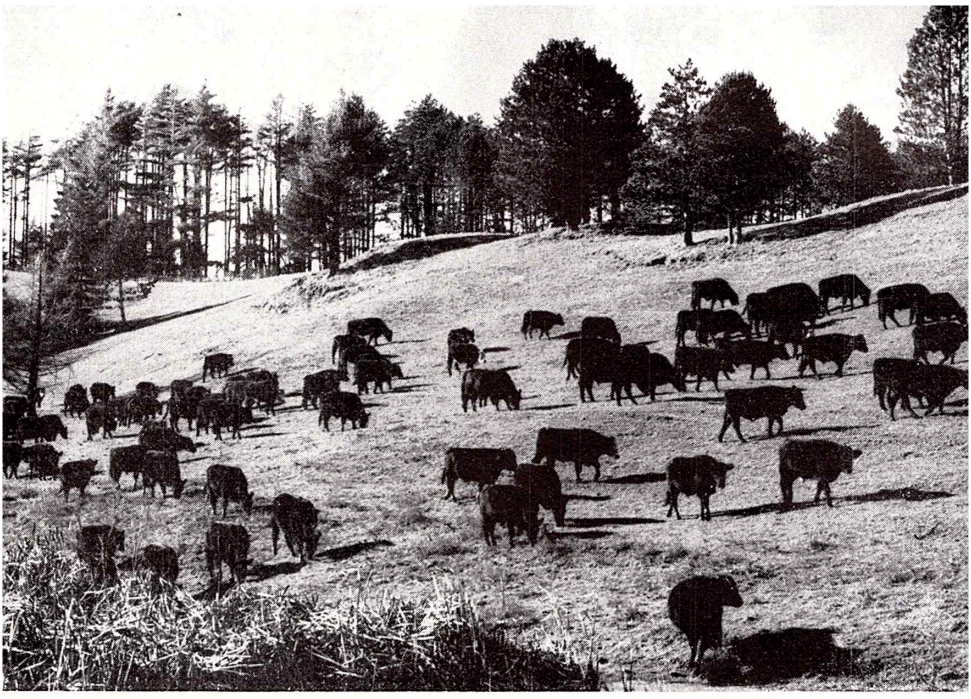

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IMPROVING THE PRODUCTIVE PERFORMANCE OF BEEF CATTLE

R. A. BARTON*

THE OBJECTIVES in a beef cattle enterprise can be simply stated. The farmer carries cattle to make money directly from them. He also uses cattle to control pasture growth and certain weeds so that sheep will thrive better. This is one of the indirect benefits of carrying cattle on sheep farms. The profit motive is always uppermost and ways and means of breeding and managing cattle for larger cash returns will naturally be of great concern to farmers.

In New Zealand, beef cattle have for too long been neglected in research and it is only very recently that any scientific assessment of their performance in this country has been undertaken. This is a regrettable state of affairs when it is remembered that beef cattle numbers are now greater than the total number of dairy cattle in New Zealand. Beef is a very important export commodity, nearly

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all of which is shipped to America at prices in excess of those ruling in Great Britain. It is imperative that beef cattle should no longer be the Cinderella of the pastoral industry.

Because of the lack of much precise information on beef cattle in New Zealand, it is necessary to draw heavily on the published results of experiments conducted in other countries, notably the United States. An attempt will be made to summarize these findings and modify the recommendations to best fit the needs of the New Zealand industry. The paper will fall into two parts. One part will be devoted to what the stud breeder can do to breed cattle for greater productivity, and the other will consider what can be done with the commercial run herd to increase profits.

Breeding for Higher Performance in Stud Herds

The stud breeder has a responsibility to fulfil. It is he who largely sets the genetic level of the productivity of the national herd. If he breeds for minor characters to the neglect of those of economic importance, then he is holding back the industry. He must see clearly the requirements of the national beef industry and then do all in his power to meet them.

The aims and objectives in cattle breeding are clear-cut when fancy points unrelated to production are jettisoned. They are:

(1) High rate of daily liveweight gain in growing and fattening cattle.
(2) Regular breeding.
(3) Docile temperament.
(4) Absence of defects such as bad feet, jaws or udders.
(5) Acceptable conformation.

These characters are listed in their approximate order of importance. Some will question the wisdom of relegating conformation to the last item. This was done advisedly because there is a large amount of evidence showing that there is a poor relationship between live animal conformation and carcass conformation and because accepted conformation — that is, deep body, well-developed fore-end and level back — is largely antagonistic to the modern requirements of the meat trade. Further, conformation is markedly affected by the level of feeding.

All studies made so far have indicated that growth, efficiency of liveweight gain (expressed as amount of food eaten per pound of liveweight increase), live animal con-

formation, and carcass characteristics, have heritabilities high enough for selection to be effective in changing the productivity of the next generation of cattle. Reproductive rate of beef cows is not likely to be quickly altered by selection because it is weakly inherited. However, one study made in New Mexico showed that large type Hereford cows had a calf crop which was 12.2 per cent. higher as compared with compact Hereford cows. It was also found that the large cows were better adapted to the rigorous range conditions and were therefore able to maintain higher reproductive rates. The same general picture emerged from a study of conventional and comprest cows under Colorado range conditions in that the conventional cows had an 8.4 per cent. higher calf drop.

Performance testing or liveweight gaining ability or weight-for-age, as it is variously called, can be undertaken in stud herds. Breed societies in the United States and Great Britain have designed programmes to assist stud breeders to achieve higher productivity in their animals, as also have university colleges of agriculture in Canada and the United States. In essence, the schemes involve determining the birth date of the calf, recording the identity of the dam, and weighing the calf at birth, at weaning, and subsequently during defined periods of its growth. The results are usually expressed as pounds of liveweight gain per day and they may be adjusted to a constant age and corrected for sex of calf and age of dam. These adjustments are designed to put all animals on a common basis so that selection can be more effective. The animals with the greatest daily liveweight gain are clearly the ones to be considered to go into the herd as sires and dams of the next generation of calves. The only equipment needed to put the scheme into operation is a set of scales. The only special qualifications required of the breeder are interest, perseverance, and a knowledge of the requirements of those who buy his cattle.

At this point it is necessary to consider the term "early maturity". Professor J. H. Knox of New Mexico State University recently said this about early maturity: "It can mean many things. In this case it should mean the ability to reach market weight and finish at an early age. Cattle which gain rapidly and efficiently are good doing cattle which fatten quickly. Small size has been confused with early maturity. They are not the same. Little cattle fatten at lighter weights but not at younger ages."

Commercial cattle breeders could insist on buying their bull requirements from stud herds where liveweight gain

is high in priority as a breeding goal. It is pleasing to report that there are increasing numbers of stud herds in New Zealand whose owners are weighing animals and are in a position to supply information on their rates of gain.

There are large differences in liveweight gaining ability of cattle and much of the variance is hereditary. Take weaning weight as an example. If the average weaning weight of the calves in a herd is 400 lb and it is desired to increase this average, then the selected parents would have to have offspring which average greater than 400 lb. If the selected parents had calves which averaged 500 lb, then the expected genetic gain would be: (500 lb minus 400 lb) = 100 lb, multiplied by the heritability estimate for weaning weight (which is 30 per cent.), thus 100 lb × 0.30 = 30 lb. This means that the next generation of calves would at weaning weigh 430 lb, that is, a gain of 30 lb on the previous generation. This is a worthwhile gain because it is permanent and accumulative from year to year. Thus, over a 15- to 20-year period, production in a herd in which systematic selection has been practised should be noticeably superior to herds where no such effort has been made.

Not all high-gaining bulls will leave high-gaining offspring, but this does not mean that selection of bulls on gaining ability is unsatisfactory. The effort to breed for greater productivity must be made in the interests of profit and efficiency in the beef industry.

Progeny Tests of Hereford Bulls for Rate of Liveweight Gain

An example of a progeny test of bulls differing in their rates of liveweight gain is given in Table 1. The figures shown are averages of five seasons when, in each season except one, three yearling Hereford bulls were used on high grade Hereford cows. One of the three bulls was selected on its relatively high rate of daily weight gain, another for its medium rate of gain and another for its low rate of growth. The offspring were identified at birth according to sire and dam. The calves were weighed at weaning and then placed on feed and weighed at regular intervals to give information on their rates of gain.

Four out of the five bulls selected as high gainers sired offspring which were likewise high gainers. In one year, however, a low-gaining sire left the fastest gaining offspring. From the figures given in Table 1, however, it is quite clear that, on the average, the offspring gained weight in the

same relative order as their sires. This situation indicates, of course, that, to get an accurate appraisal of a bull's breeding worth, it is necessary to breed from him and examine his offspring. There is, however, a considerable loss of time if the breeder wishes to obtain a progeny test and, therefore, with a highly heritable character like rate of liveweight gain, he would be better, on the average, to select bulls on their own rates of gain and dispense with the progeny test. This is recommended even though an occasional bull will not leave calves that perform like himself in their rate of growth.

TABLE 1: Weight gains of progeny groups of Hereford cattle (Texas Agricultural Experiment Station data published by Maurice Shelton, T. C. Cartwright and W. T. Hardy in Cattle Series 137, Progress Report 1958)

	SIRES		OFFSPRING					
Group	No.	Gain on Test (lb per day)	No.	Adjusted Weaning Weight (lb)	Gain on Test (lb per day)	Final Weight (lb)	Weight per day of Age (lb)	Adjusted 420-day Weight (lb)
High gainers	4	3.03	41	438	1.92	756	1.81	760
Medium gainers	5	2.52	47	430	1.82	715	1.72	722
Low gainers	5	1.89	59	418	1.72	692	1.68	704

Performance Tests of Hereford Bulls

In a beef cattle performance test conducted at the Texas Agricultural Experiment Station, McGregor, Texas, 48 Hereford bulls were fed together for 140 days so that their daily liveweight gain could be determined. The average daily gain for the 48 bulls was 2.5 lb but this varied from 3.1 lb, with a gain ratio of 123, to as low at 1.9 lb with a gain ratio of 75. (Gain ratio is expressed as a percentage above or below the average of the group of bulls under test. For example, a bull with a gain ratio of 123 is one which is 23 per cent. above the average of the bulls tested.) During this test period the highest gaining bull increased in weight by 438 lb and achieved a final weight of 1,071 lb at 487 days of age. The lowest gaining bull gained only 267 lb to give a final weight of 926 lb at 476 days of age.

These figures highlight the considerable variation in the performance of bulls under test. Some of this variation has an hereditary basis and is therefore capable of being passed on to the bull's offspring.

Other characters that can be improved by selection, such as mothering ability, cancer-eye resistance and various carcass traits, could be discussed but these are subjects in themselves. Sufficient has been considered to show that the stud breeder can achieve much by a systematic approach to selection for production characters.

Improving Productive Performance in Commercial Herds

Hereditary improvement in commercial run herds is often a little more difficult to achieve simply because of the problems of identifying each member of the herd in large paddocks. Cattlemen anxious to bring about improvements in their herds will no doubt work out a system of identification best suited to their needs. These few suggestions may be of help in solving this problem. Brand a number on each cow or use neck chains with number tags, or eartag the cows and their calves.

Identification of cow and calf makes it easy to cull cows on the way they are producing. If accurate methods of identification cannot be used, then draft off the poorest calves at weaning time according to type, size and bloom. Allow these undesirable calves to find their mothers some hours later and then cull both cow and calf.

It is important in an efficiently managed herd to know the ages of the cows. This can be done by age-marking, a procedure which allows culling for age to take place accurately. Without age identification, many young cows that have produced heavily may be culled in the mistaken belief that they are old and worn out.

The fertility of the breeding herd is of the utmost importance. The aim therefore is to have every cow produce, at yearly intervals, a good calf at weaning and to have 90 per cent. or more of the cows calve down within an eight to 10 weeks' period.

Steps designed to achieve this aim can be listed as follows:

(1) Have each bull tested for fertility at the commencement of every breeding season.
(2) Mate one bull to 30 to 35 cows in one paddock wherever possible. Shift the bulls from each cow mob at three-weekly intervals to ensure that infertile bulls do not stay too long with one mob of cows.
(3) Limit the mating period to 12 weeks.
(4) Mate virgin heifers two to three weeks earlier than older females. Virgin heifers require more services than mature cows to get in-calf.

(5) At weaning, vaccinate all heifer calves against contagious abortion. Strain 19 vaccine is a "live" vaccine so that injections must be given by a veterinarian or livestock instructor. Where blackleg is a problem, vaccination against this disease must also be undertaken.

(6) All breeding cows ought to be pregnancy tested. An experienced person can do this with accuracy any time after 60 days following the end of mating. Non-pregnant cows should be removed from the herd at this time as also should late-calvers, as these will either be empty the next year or late again.

(7) Do not buy in or borrow a bull which has been used in another herd. This practice could introduce diseases like vibrionic abortion and trichomoniasis into the herd as both are venereal diseases.

(8) Buy replacement bulls from stud herds where it is possible to obtain figures on the liveweight gain of the animals. Attempt to buy bulls with the highest daily gain in weight. Temperament, feet, jaws, reproductive organs and conformation all must be considered in making the selection too.

(9) Consider the advantages of crossbreeding. Performance in herds where crossbreeding is practised is usually higher for fertility, weaning weight and survival of animals. By choosing appropriate breeds, crossbreeding can be done so that the offspring do not grow horns and are of acceptable colours.

(10) Wean when the calves are five to six months of age. This gives both the calves and the cows an opportunity to make gains before winter sets in. The cows can then be used if need be for control of rough pastures but they must not be allowed to lose too much weight before next calving.

(11) Freshen up the cows before calving as this will ensure big and strong calves at birth. Do not, however, overdo this treatment or calving difficulties may arise.

(12) Aim to calve down a week or two before the anticipated normal date for the commencement of the spring flush of feed. This practice allows the calves to have a little size on them before the cows reach their peak of milk production. If the calf is unable to consume all the milk produced, then the cow will partially dry off and be unable later to meet the growing needs of its calf.

(13) Cull cows for defects of feet, legs, jaws, udder, prolapse of the vagina and uterus, permanent eye injury or cancer eye.

(14) Cull cows with a nervous temperament and those with poor mothering ability.

(15) On properties where young stock grow rapidly, consideration ought to be given to mating the largest heifers as yearlings rather than as two-year-olds. Where this is practised it is wise to use young and light bulls and to wean the heifer's calf about a month earlier than the date chosen for the older females. Early breeding will not have any detrimental effect on the subsequent performance of the females. Indeed there is evidence to suggest that the lifetime performanc of early-bred females is higher than the performance of females bred first as two-year-olds.

(16) Management of the herd must be highly efficient to achieve the goals given earlier. Thus provision of water and feed must be adequate, handling during mustering and in the yards must be firm but gentle, and operations such as castration, marking, branding and dehorning, must be conducted in an approved manner. Regular inspection of the brood cows and calves at calving and mating must also be undertaken.

(17) Female herd replacements must be selected for their size and growth and for temperament and absence of defects. From the time they are weaned until mating, they should be fed to gain at the rate of about one pound per day. This means that at mating they will not be fat but will have size and be in moderate condition.

(18) Drenching against internal parasites in young stock must be undertaken whenever necessary.

(19) Spray young stock to control lice.

(20) If the farm has a mineral deficiency, then this must be made good by topdressing or by providing a lick (which is not so successful as topdressing), or by treatment of the animals with a "bullet" containing the lacking element, or by injection of the deficient mineral into the body of the animal.

Greatly increased efficiency is possible with growing and fattening steers for slaughter. Many of the points already considered also apply to steers. This is especially true in the case of breeding for high rates of gain. Control of internal and external parasites, and gentle handling, are obviously also important. Their feeding need not be lavish but the aim should be to have them finished at 18 to 22 months at carcass weights of about 550 pounds. A carcass at this weight and produced by a young animal is not too fatty and

wasty, nor is it tough. Thus it meets the fastidious demands of the modern beefeater. If steers are not slaughtered before they are 22 months of age, they then go into their third winter with all the extra costs of feeding and delay in selling that this involves. This would make for an unprofitable enterprise except where there is a high-priced local market for fresh beef in the winter and spring months.

It is clear from this listing that efficiency in the beef cattle enterprise involves many different items and a working knowledge of some complex processes such as reproduction. The stimulus to strive for the goal of high production with beef cattle is the profit motive but the sheer love of the animals is also important. Many more producers of highly productive cattle are needed if cattle are to make a substantial contribution to the national economy as they are certainly capable of doing. Remember always that beef is the preferred meat of people in all countries enjoying high standards of living. The challenge is to meet their requirements before some other exporting nation does.

DISCUSSION

Q : : *Could the speaker comment on the practice of some stud breeders who use nurse cows for the raising of young bulls?*

A : : This practice is widely used in all countries having a highly developed stud beef cattle industry. Allowances can be made for the added growth of bulls raised in this fashion so that bulls within a herd can be compared for their daily liveweight growth irrespective of whether they were reared on a nurse cow or not. However, the practice should be condemned because it may eventually produce beef cows with poor milk yields and this would have serious consequences in the commercial herds. Bulls which have been overfed as the result of suckling nurse cows and consuming excessive amounts of concentrates may be less fertile than those fed more moderately. They may also "founder".

Q : : *It has been advocated by a member of the Ruakura staff that beef cows ought to be crossed with a dairy-bred bull so that the female offspring would produce more milk and hence have heavier calves at weaning. Is this likely to be the case?*

A : : As yet no one has made this cross and measured the weaning weight of the calves from the first cross cows and compared them with comparably raised beef-bred calves. If the Friesian was the dairy bull used, it is quite possible that weaning weights of calves would be heavier than straight beef-bred calves because the Friesian grows more rapidly than British breeds of beef cattle.

The problem of increasing the weaning weight of calves is not solely one of high milk production of the cows. If the cow produces more milk than its calf can consume, the cow partially dries off. Thus a cow capable of high milk production in a milking herd would soon yield an appreciably smaller amount of milk if it were

suckled by its own calf only. It is generally believed that a calf consumes milk equal to about 10 per cent. of its liveweight. Thus, at birth it may weigh 70 lb and consume daily about 7 lb of milk. By the time the calf is double its birth weight the cow may not be capable of supplying it with 14 lb of milk because it was earlier producing at or about this amount but it was unconsumed and, accordingly, the cow partly dried herself off.

Q : : *Are licks beneficial to cattle even though there is no known mineral deficiency on the farm?*

A : : Many investigations have shown that salt licks suppress appetite of cattle and therefore they retard their growth and fattening. Licks containing trace elements and other minerals may supply the animals with more than their optimum requirements and this could lead to reproductive failures in breeding cows and possibly there would be other deleterious effects.

Q : : *Why are Herefords more susceptible to cancer eye than other breeds?*

A : : Cancer eye can occur in all breeds of beef and dairy cattle in this country but it is true to say that Herefords are more prone than all other breeds but the incidence is very low indeed — probably less than one per cent. Many Hereford cattle do not have sufficient pigment about the eyes and in the eyeball and this makes them more susceptible to cancer eye through the irritating effects of sunlight and other factors.

The incidence of cancer eye in herds can be greatly and quite quickly reduced if breeders cull breeding cattle that develop the condition, together with their progeny. The condition in Herefords has been shown to be quite strongly inherited. Bulls should never be used if they have any ancestors with cancer eye. Selecting for dark pigmentation about and in the eye will reduce the incidence of the disease but will not be as successful as selection against the disease.

Recent studies in Oklahoma have shown that well-fed Hereford cows have a much higher incidence of cancer eye during their lifetime when compared with poorly-wintered cows in the same experiment. This is an interesting observation that is of great interest in the study of cancer eye in humans, and for this and other reasons cancer societies in America are supplying funds for the study of this disease in cattle in the hope that findings of importance to the problem of cancer in humans may be uncovered.

Q : : *Does the speaker consider that there is a future in New Zealand for the Santa Gertrudis breed of cattle?*

A : : One of my objects in visiting the King Ranch in Southern Texas was to see the Santa Gertrudis cattle and enquire about their possible suitability for New Zealand conditions. These cattle were evolved on the King Ranch by crossing Brahman cattle, which originated in India, with Shorthorns. The cross was stabilized at five-eighths Shorthorn and three-eighths Brahman blood. The cattle are large, red coated, horned, and have tremendous hindquarter development. They have droopy rumps, pendulous sheaths, navels, ears and dewlaps, and a hump on the shoulders. Although their conformation is vastly different from that of the British breeds, their carcasses on the hooks are not noticeably inferior.

I asked Mr A. O. Rhoad, the geneticist at King Ranch, whether he thought there was a place for Santa Gertrudis cattle in New

Zealand. His answer was in the negative. These cattle were bred on flat land to survive under conditions unknown in New Zealand — that is, very high temperatures, high humidity, prolonged drought in a semi-desert and the presence of cattle tick fever.

It is said that the fertility of the Santa Gertrudis cattle is below that of British beef breeds and, because of the very pendulous sheath, bulls often suffer injuries that affect their ability to mate. The growth rate of this breed has been compared with other breeds and crosses in beef cattle gain performance tests run under the joint control of the Texas Agricultural Experiment Station and the U.S. Department of Agriculture. The Santa Gertrudis breed and its crosses have not been noticeably and consistently superior to other breeds and crosses tested at the same research station. Aberdeen Angus, Brahman, Charbray, Red Poll, Brown Swiss, Hereford and Santa Gertrudis cattle and various crosses were compared in these performance tests. The Santa Gertrudis breed is well suited to unfavourable environments of kinds quite unknown in New Zealand but which are common in Australia where the breed is making an increasingly important contribution to its beef industry.

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INDEX, 1932-1962

A NOTE ON THE TITLE

THE first annual meeting of sheepfarmers conducted by Massey Agricultural College was called in 1932 and the papers presented, together with discussions on them, were published in that year under the title of *Proceedings of a Meeting of Sheep Breeders*. This title was retained for the following three years. The 1936 volume was changed to *Proceedings of the 5th Annual Meeting of Sheep Farmers*. *Proceedings* of the 6th, 7th, 8th and 9th meetings were issued in the years 1937 to 1940. Because of the war, the meetings were suspended, and the *Proceedings* of the 10th meeting did not appear until 1947. In 1948, the present title, *Sheepfarming Annual*, was adopted, and the volumes from *Sheepfarming Annual 1948* to *Sheepfarming Annual 1962* include the proceedings of the 11th to 25th annual meetings of sheep farmers.

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